CIVIL ENGINEERING

VENEZUELA SUPERHIGHWAY

Siblesz • Smillie • Phinney

Freyssinet • Muller • Shama

RAYMOND

solves another tough job!

at left
Sinking Gow caissons for Detroit's City-County Building

FOUNDATION CONTRACTOR:
O. W. Burke Co.

ARCHITECTS & ENGINEERS:
Harley, Ellington & Day, Inc.

CONSTRUCTED FOR:
Detroit-Wayne Joint Building Authority

... **To provide** the foundation for the City-County Building in Detroit's new Civic Center, Raymond placed 126 Gow caissons, with diameters of 48 to 74 inches, to depths exceeding 100 feet to hardpan. The caissons were belled out on the hardpan to varying diameters. Completion of this project ahead of schedule is another example of how Raymond engineers combine knowledge and experience with specially designed equipment to provide <u>any</u> type foundation <u>anywhere</u>. We would like to serve <u>you</u> on your next project.

RAYMOND CONCRETE PILE CO.

140 CEDAR STREET • NEW YORK 6, N. Y.

BRANCH OFFICES IN THE PRINCIPAL CITIES OF UNITED STATES AND CENTRAL AND SOUTH AMERICA

AROUND THE WORLD — FOUNDED 1897

THE SCOPE OF RAYMOND'S ACTIVITIES . . .

Foundation Construction . . . Harbor and Waterfront Improvements . . . Soil Investigations . . . In-Place Pipe Lining . . . Specialized Construction.

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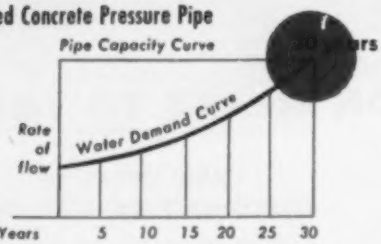
Pipe for First Barrel of San Diego Aqueduct... Installed in 1945-46. American Pipe and Construction Co., supplied 114,340 ft. of 72" Lock Joint and 42" Lock Joint reinforced concrete pressure pipe for heads ranging from 50 to 550 ft.

Do you know how much water your community will need 50 YEARS FROM TODAY?

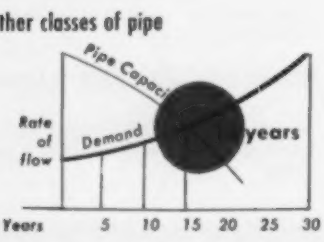
DO YOUR PRESENT MAIN WATER SUPPLY LINES HAVE THE PERMANENCE AND SUSTAINED HIGH CARRYING CAPACITY TO MEET THAT DEMAND?

All community water engineers know that the growth of a city, town or village and the water demands that will be made in 10, 20 or 50 years are extremely hard to calculate or predict. Many engineers find a partial solution to this difficult problem by specifying American Reinforced Concrete Pressure Pipe with its advantage of *sustained* high carrying capacity.

Reinforced Concrete Pressure Pipe



Certain other classes of pipe



SAN DIEGO . . . A TYPICAL EXAMPLE

The unexpected growth factor is exemplified at San Diego, Calif. The San Diego Aqueduct was installed in 1945-46 to serve the cities, population centers, agricultural areas, and military installations within San Diego County. At that time, prior to the Korean outbreak, engineers provided for a Second Barrel, to be installed in the future. Today, *only 6 years later*, contracts have been let for that second barrel . . . a facility demanded by San Diego County's increasing and unprecedented water demands, created by phenomenal growth and expansion. The second barrel will be installed soon . . . much sooner than anyone expected in 1946.

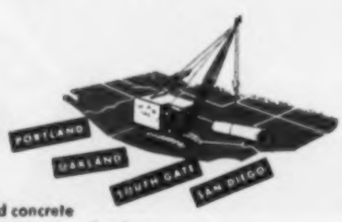
The San Diego Aqueduct is only one of the prominent examples of the long range point of view required on water supply projects. Specifying a class of pipe which forestalls the danger point at which demand exceeds supply is a part of the solution to the problem of unexpected growth.

The products manufactured by American Pipe and Construction Co. . . . four different types of reinforced concrete pressure pipe . . . are intended and carefully designed for use in such permanent main water supply line projects. American reinforced concrete pressure pipe assures sustained high carrying capacity as illustrated graphically in the accompanying diagrams.

LET OUR EXPERIENCE HELP YOU

Our 50 years of experience in design and manufacture . . . and our continuing program of research and development in this field . . . are available in helping your community plan its water projects wisely.

Direct your inquiries to any of our plant offices, and be assured of an immediate reply . . . plus informative bulletins on the type of reinforced concrete pressure pipe that will best meet your needs.



FOUR PLANTS TO SERVE YOU

American manufactures four classes of reinforced concrete pressure pipe in diameters ranging from 12 in. to 12 ft., and for all pressures related to modern American water works practice.

American PIPE AND CONSTRUCTION CO.

Concrete Pipe for Main Water Supply Lines, Storm and Sanitary Sewers, Subaqueous Pipe Lines
P. O. Box 3428, Terminal Annex, Los Angeles 54, California
Main Offices and Plant—4635 Firestone Boulevard, South Gate, California
District Offices and Plants—Oakland, San Diego—Portland, Oregon

Caterpillar Diesel armada pushes through new Pensacola jet base

THIS NO. 12 Motor Grader is leveling one of the long jet runways at the Forrest Sherman base.

A CAT D13000 Diesel Engine powers a Bucyrus-Erie dragline, moving shell from stock pile to crusher.

Building the roads and runways for the new Forrest Sherman jet base at Pensacola, Florida, is pretty much a Caterpillar show. Smith Engineering & Construction Co., of Pensacola, uses about 75 of the big yellow machines, including all types of equipment.

The land on which the installation is being built was an Army fort during the last war, and will now become part of the big Pensacola Naval Air Station. The runways are 70% crushed shell mixed with 30% sand and spread 17 inches deep. This is compacted to a 12-inch finished base.

Earth taken from the cut for the runways is used as fill for a new entrance road to the field. 180,000 cubic yards will be moved on the road-building job, and it is being done by fast Cat DW21 Tractors and No. 21 Scrapers, hauling loads up to 20 heaped yards.

A Woods mixer, pulled by a D8 Tractor, is used for rapid mixing of the runway material. And Cat No. 12 Motor Graders prepare the ground and level the mix.

Mr. A. W. Gordon, Superintendent, says: "At one time we had about 50 machines of other makes. We've gradually sold them out and standardized on Caterpillar. I'm partial to them, having worked one of the first tractors sold, back in 1928. Some of our

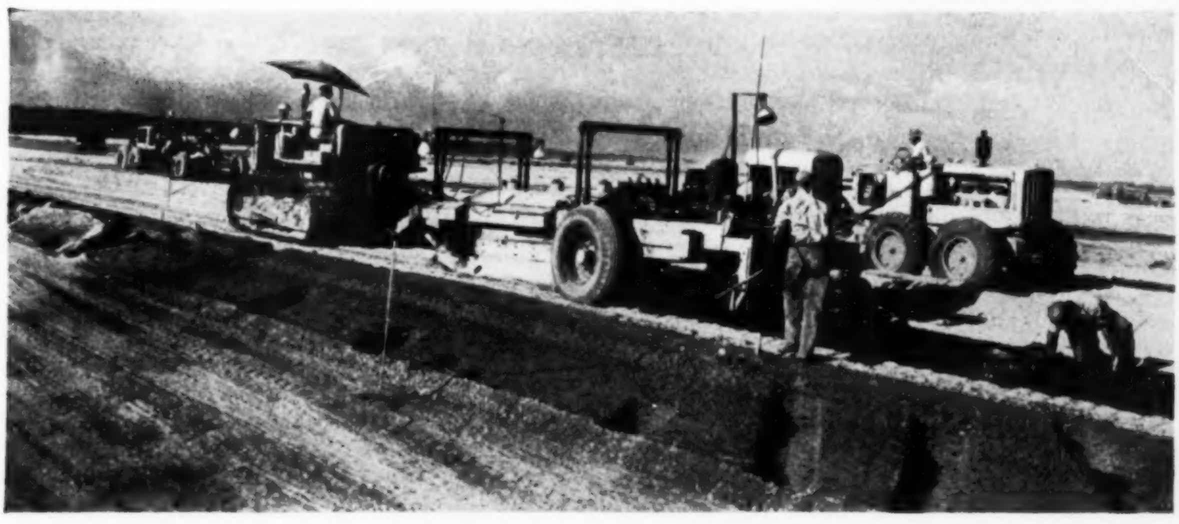
present Cat equipment is more than 10 years old and still running strong."

Standardizing on Caterpillar machines is sound practice. It simplifies the problem of operator training, allows quick repairs with interchangeable parts, and places undivided responsibility on one manufacturer and one dealer.

Your Caterpillar Dealer has the right equipment for your job, and he'll back its rugged stamina and long work life with reliable service and genuine Caterpillar parts. He's as close as your phone. Call him today.

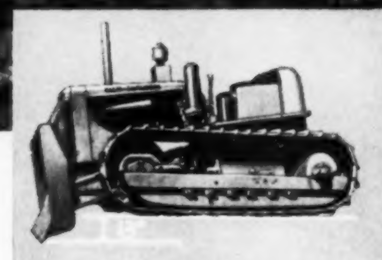
ROLLING at 20 mph., a Cat DW21-Scraper unit hauls big loads fast for building an entrance road.

A CATERPILLAR D8 Tractor pulls this Woods mixer, laying crushed shell and sand for a runway.



CATERPILLAR TRACTOR CO., PEORIA, ILLINOIS


NOTICE
THIS ROAD
CLOSED
To Truck or Heavy Traffic
UNTIL FURTHER
NOTICE
Lake County Highway Dept.



BITES DOWN HARD. Full 13-in. drop below ground, positive down pressure plus steep angle of penetration mean fast digging.

Here's a Big Advance in Bulldozing Performance

This bulldozing team introduces new dirt-moving ability; a new, narrower-width blade for transporting by highway; new ease of servicing and operation — all at a new low cost.

Here are some specific characteristics that make it such a productive combination for many dozing jobs:

A great tractor. This popular Allis-Chalmers HD-9 Tractor has power, weight and balance that put it in a class by itself.

A revolutionary team. Here is a tractor-dozer combination, designed as a unit, which compares in performance with conventional "dozers" weighing from five to six thousand pounds more.

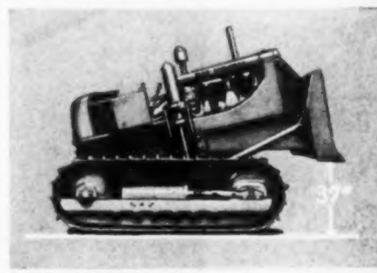
No push-beams. A completely new idea in bulldozer engineering, the Baker 9X blade is mounted directly to the HD-9 main frame. Tractor main frame and dozer are raised and lowered as a single unit.

Lighter weight — better stability. Almost 1,150 lb. lighter than standard dozer. Costs less to buy. And with lighter blade mounted 15 inches closer, tractor center of gravity is not upset. No excess wear on front truck wheels and support rollers.

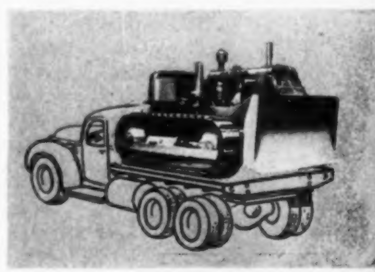
Big dirt mover. Because of extra clearance, greatly increased track oscillation and better balance, this team is a phenomenal performer in mud and tough going. And with blade fully six inches higher, capacity is kept on par with conventional blade.

Simplified servicing. 1,000-hour lubrication of truck wheels, idlers and support rollers. Dozer mounting does not interfere with engine accessibility. No removal of major tractor assemblies.

Easy to operate. Just by pulling a single lever, operator can shift from any of the six forward speeds to any of the three high-speed reverses. This, plus narrow, frame-mounted blade, makes the HD-9 particularly fast and maneuverable.



HIGH LIFT. Full 37 in. above ground. Excellent for pushing over trees and stumps and clearing brush.



EASIER HIGHWAY TRANSPORT. Blade is only 8 ft. wide — no transport permit needed.

THE FINEST LINE ON EARTH

ALLIS-CHALMERS

TRACTOR DIVISION • MILWAUKEE 1, U. S. A.

It's the Operators'

BEST BY A DAM SITE. Troy Hood and Jack Rank (shown here with Dirt Foreman Sam Crawford) operate TD-24s for Guy H. James, building the great Oahe Dam in South Dakota. Hood says: "I can keep right behind the scrapers—catch 'em sooner and push 'em out faster because TD-24 controls are easier." And Rank chimes in: "Much easier to handle than any other tractor."

"ALMOST THINKS FOR ITSELF!" That's what Jess Leatherwood says about the Big Red TD-24 he operates for Macon Construction Co., Franklin, N. C. "It pushes more, moves it faster and handles easier than any other crawler I've ever been on."

"WE RIP PLACES YOU'D USUALLY HAVE TO BLAST," says another Macon operator, Roy Cantrell. "We've been working in the Blue Ridge Mountains on rock you couldn't touch with a dozer till the TD-24 came along. Now we blade where we couldn't scratch before, and rip where we used to dynamite!"

"OUR TD-24s REQUIRE LESS SERVICE," says John Tickler, Service Superintendent for John E. Bloomer Construction Co. "These big red machines are very accessible, very easy to maintain. And when we do need help, the International Distributor is always on the job!"

Crawler!

TD 24

Read what the operators and servicemen say about "Big Red", the International TD-24...

"HOW DO I LIKE 'BIG RED'?" asks George Miller. "Listen: This TD-24 is just the fastest and surest handling tractor there is, that's all! Nothing I've seen can touch it for moving dirt." George and his TD-24 move dirt in North Carolina for Kiker & Yount Construction Co.

"GREATEST THING I'VE SEEN," says Bruce Olson (right), TD-24 operator and Sec.-treas. of G. A. Olson Construction Co., Marshall, Minn. "The TD-24 is the easiest crawler of all to operate. The high-low shift is great for whipping around to the cut after dumping the load. It's the fastest equipment going for anything up to a 3,000-foot cycle!" Man in center is Glen Olson, Bruce's brother and company president. At left is Superintendent Donald Young.

Ask the men who know. Ask the operators. They know that *this* makes "Big Red" the Champ:

TD-24 POWER

148 maximum drawbar horsepower, more than any other crawler on the market.

TD-24 SPEED

Up to 7.8 m.p.h. with 8 forward speeds, 8 reverse. Moves loads faster, gets back quicker for more work-cycles per hour.

TD-24 STEERING

Fingertip control for pivot-turns, feathered-turns and *turns with power on both tracks.*

TD-24 STARTING

Exclusive International push-button starting for quick starts any time in any weather.

Want to know more reasons why the Big Red TD-24 is the work-champ of the world?

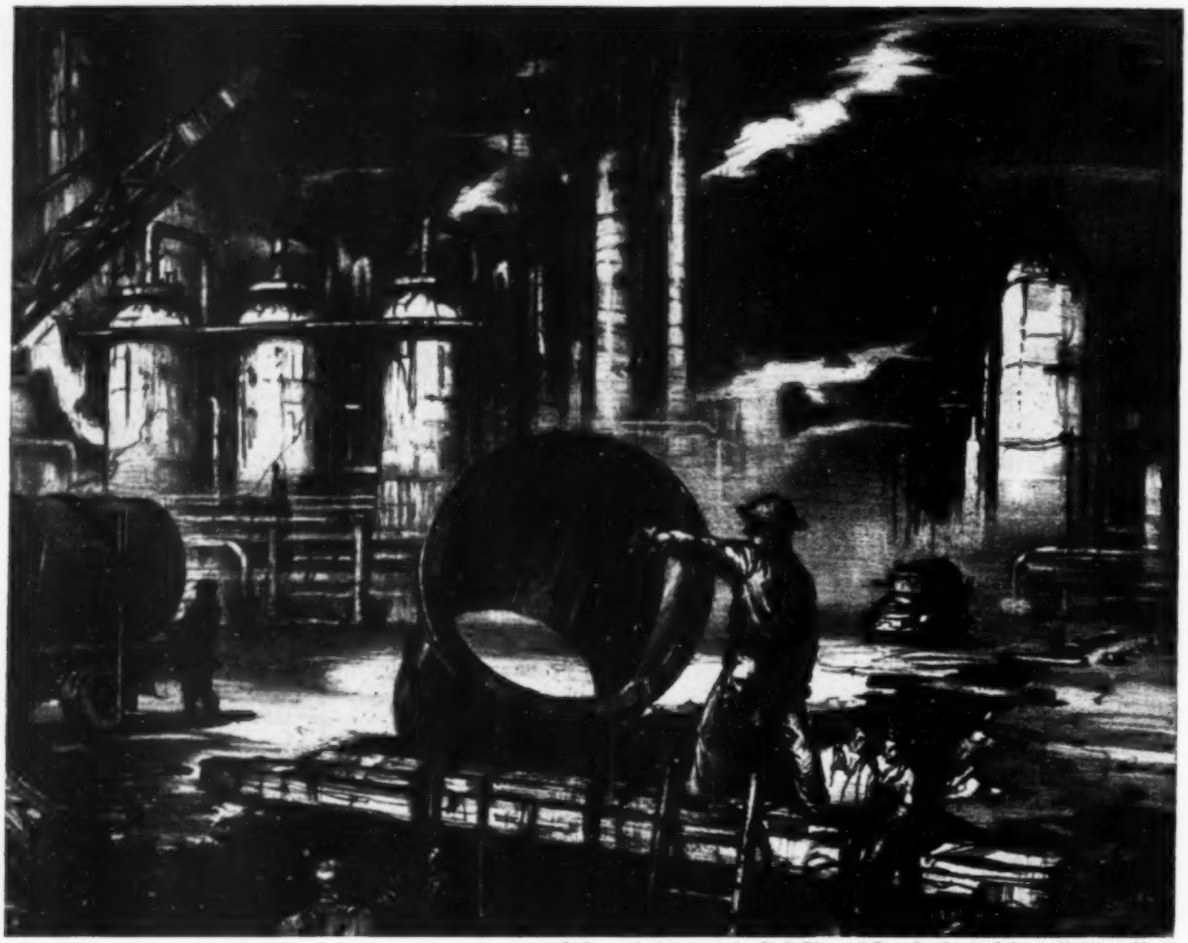
Ask your International Industrial Distributor. Ask TD-24 operators. Ask the men who know—and you'll be a TD-24 man yourself from then on in!

INTERNATIONAL HARVESTER COMPANY, CHICAGO 1, ILLINOIS

INTERNATIONAL HARVESTER

INTERNATIONAL

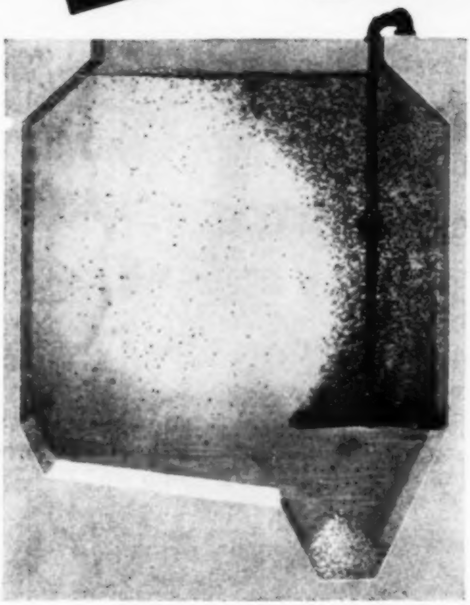
POWER THAT PAYS



Lithographed on stone for U. S. Pipe and Foundry Co. by John A. Noble, A. N. A.

CHICAGO SEWAGE EQUIPMENT

AER-DEGRITTER



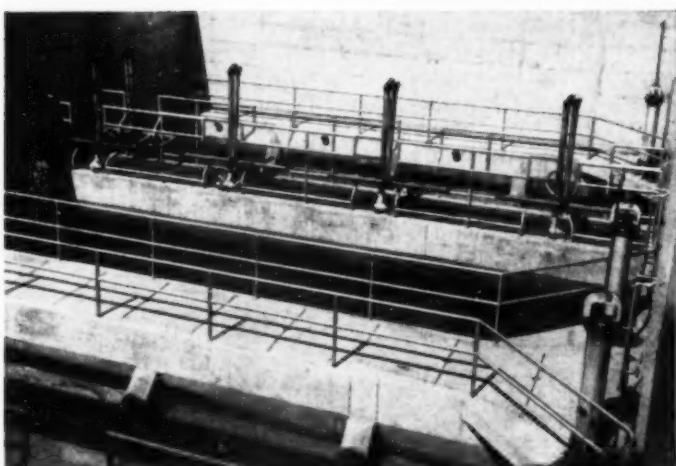
The only method of removing grit and sand from sewage without mechanical equipment is provided by the Aer-Degritter. The velocity of flow is controlled by air introduced through Swing Diffusers and Precision Diffuser Tubes. All sand of 0.2 mm. (65 mesh) and larger is washed and deposited in the bottom of the tank.

Less than 10% volatile matter and only a negligible trace of putrescible organics remains in the grit removed. Aer-Degritters may be installed ahead of all mechanical equipment because coarse sewage material will not interfere with the operation of the Aer-Degritter or affect the hydraulic design of the plant.

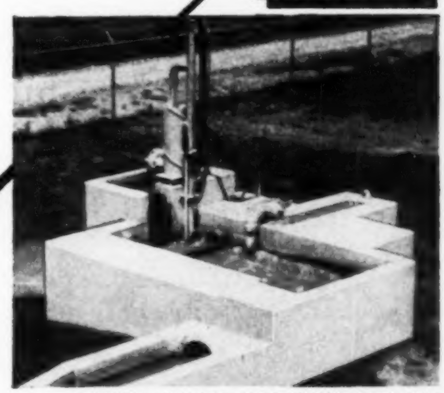
The basic features of the Aer-Degritter are:

- MAXIMUM REMOVAL • CLEAN GRIT
- NO MECHANISM • LOW COST
- SIMPLE STRUCTURE • AIR CONTROLLED VELOCITIES INDEPENDENT OF FLOW

52 INSTALLED IN TWO YEARS



COLUMBUS OHIO SEWAGE TREATMENT PLANT
Design Flow 160 M.G.D.
PAUL A. UHLMANN & ASSOCIATES
Consulting Engineers



BELLAIRE, TEXAS SEWAGE TREATMENT PLANT
Design Flow .8 M.G.D.
HILTON & COULSON
Consulting Engineers

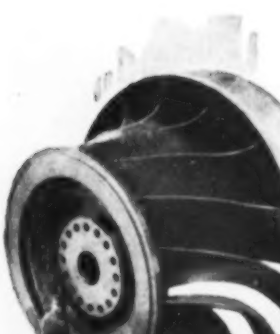
CHICAGO PUMP COMPANY

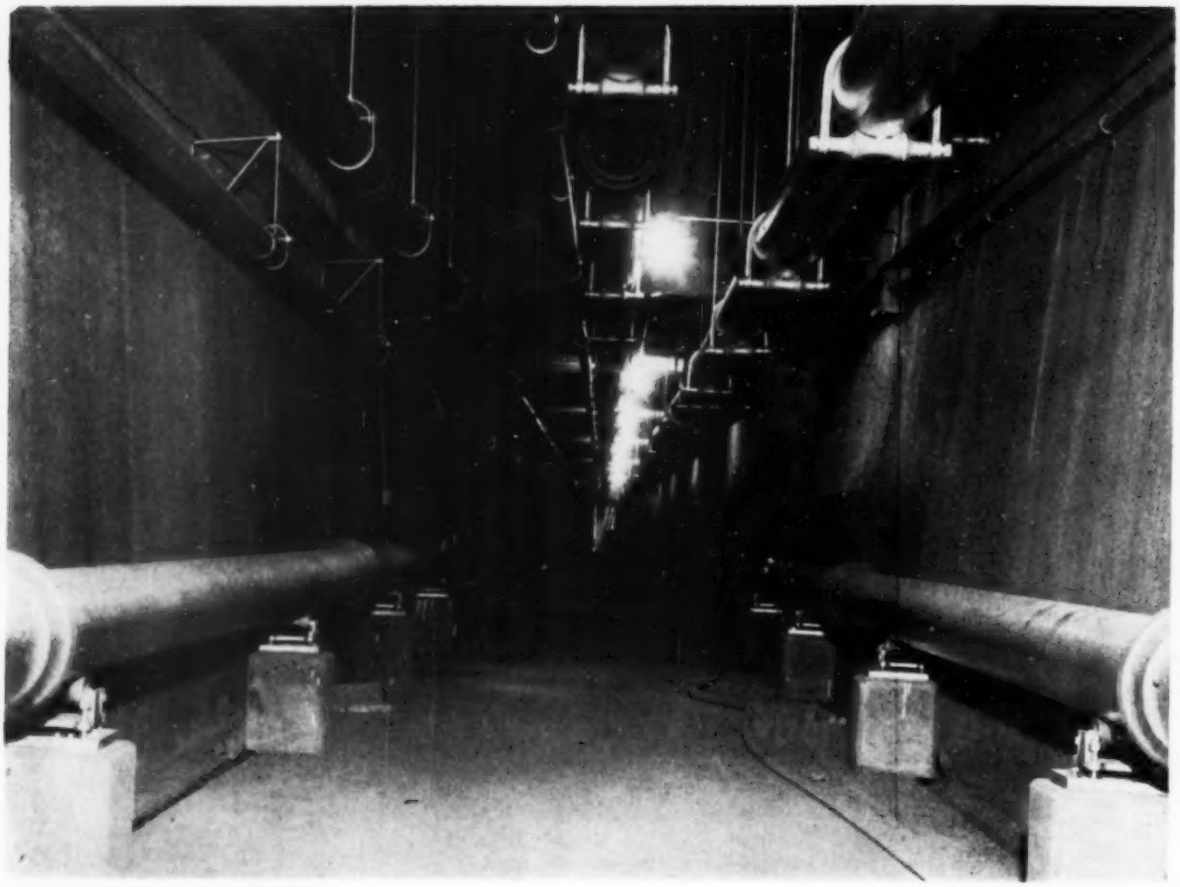
SEWAGE EQUIPMENT DIVISION

622 DIVERSEY PARKWAY **CHICAGO 14, ILLINOIS**

Flush Kleen, Scru-Peller, Plunger. Horizontal and Vertical Non-Clogs Water Seal Pumping Units, Samplers.

Swing Diffusers, Stationary Diffusers, Mechanical Aerators, Combination Aerator-Clarifiers, Comminutors.





MONO-CAST Pipe for Every Service Condition

Modern usage is continually making increasingly severe demands on pipe lines. Underground mains must do much more than merely resist corrosion. They must convey greater volumes, at higher internal pressures; they must withstand vastly increased external loadings; they must be adapted to an ever-widening range of service conditions. Mono-Cast Pipe possesses the exceptional physical strength and uniformity necessary to meet these requirements.

Mono-Cast pipe is manufactured under rigid specifications in diameters 3-inch through 48-inch. It will stand the impact of heavy loads and gives complete job satisfaction. This pipe is manufactured in specific weights for specific laying conditions. You get the exact pipe your conditions require.

It is conveying sewage, water, gas, crude oil, gasoline, sour naphtha, salt brine, Foamite fire foam, ashes —and in fact, just about everything that a pipe line can conceivably convey. It is conveying these products under operating pressures ranging from a few pounds to the square inch, up to pressures in excess of 100 pounds gas and 500 pounds liquid.

Mono-Cast Pipe serves equally well beneath crowded city streets or in sewage treatment plant installations, like the one shown above.

Being cast iron, Mono-Cast Pipe enjoys an enviable reputation. Cast iron pipe has had over three hundred years of service abroad and more than one hundred years of service in the United States. It is satisfactorily serving in locations where especially severe external and internal corrosion conditions exist. Mono-Cast Pipe is designed to give super-service and its wide acceptance and splendid performance bespeak its excellence and the confidence and esteem in which it is held by those who are using it.

Refer your next piping job to ACIPCO, and utilize the extensive manufacturing facilities of the largest individual cast iron pipe foundry in America.

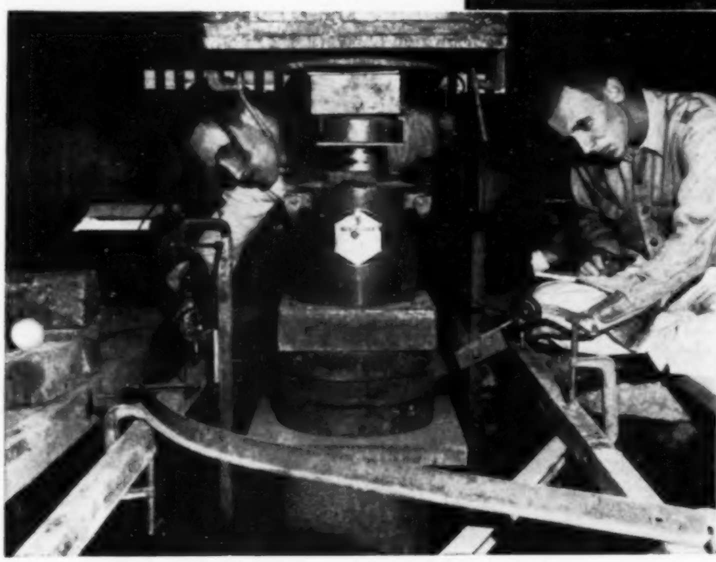
Write for free literature.

AMERICAN CAST IRON PIPE COMPANY

BIRMINGHAM 2, ALABAMA

Dallas Chicago Houston Minneapolis El Paso Cleveland Pittsburgh Los Angeles Kansas City San Francisco New York City Seattle Denver

Predesign pile loading tests



▲ Above: Four large water-filled steel tanks provided a dead load exceeding 120 tons in recent friction pile tests for the Iowa State Highway Commission.

◀ Left: During Monotube testing, dial readings were taken at specified time intervals as load increments were applied. Scales shown are only two of several reference points on instrumentation framework, which were checked by wye level each time readings were taken.

PREPARATORY to designing an overpass near Council Bluffs, the Iowa State Highway Commission conducted a series of pile loading tests. Careful engineering preparation and unusually thorough instrumentation provided highly accurate test results.

A 40-foot Monotube in fine brown sand was loaded to 112 tons with a settlement of only 0.048 inches. Specified load increments were applied by means of a hydraulic jack bearing against the 120-ton dead-weight of 4 water-filled steel tanks.

If you have foundation problems coming up, check with Union Metal for helpful engineering service . . . for accurate Monotube pile test data . . . and for the latest information on modern, easy-to-drive piles that can save you plenty of time and money. Write to The Union Metal Manufacturing Company, Canton 5, Ohio.

Monotube Foundation Piles

UNION METAL

MOTORISTS SAVE 10 TO 30 MINUTES crossing from Norfolk to Portsmouth via the new G-E equipped bridge and tunnel. Bridge is 4-lane, 2135 ft between abutments. Bascule span is of the double-leaf, rolling-lift type with leaves each 90 ft long.

Bridge's drive system helps speed 29,000 cars per day

G-E equipment at Portsmouth - Norfolk Bridge gives fast movement, positive control of leaves

The new 4-lane bascule bridge across the Elizabeth River at Norfolk, Va.—part of a combined bridge and tunnel project built for the Portsmouth-Norfolk Bridge Tunnel Commission—is currently handling over 29,000 vehicles per day. Ability to handle this heavy traffic flow is due in part to electric equipment supplied and co-ordinated by General Electric.

In helping to develop the bridge's drive system, G-E engineers worked closely with J. E. Greiner Co., consulting engineers, Tidewater Construction Corp., engineers and contractors, and Tuck and Kendall Inc., electrical contractor. Result of this co-operation: a simple, dependable drive system that expedites traffic because it is easy to operate and provides positive-action control of bridge leaves for fast movement and smooth, safe seating.

This is one more example of how G-E engineers can help your engineers or consultants on electric equipment for heavy construction projects. Contact your local G-E Apparatus Sales Office early in the planning stage. General Electric Co., Schenectady 5, New York. 664-26

1878 75 1953 YEARS OF ELECTRICAL PROGRESS

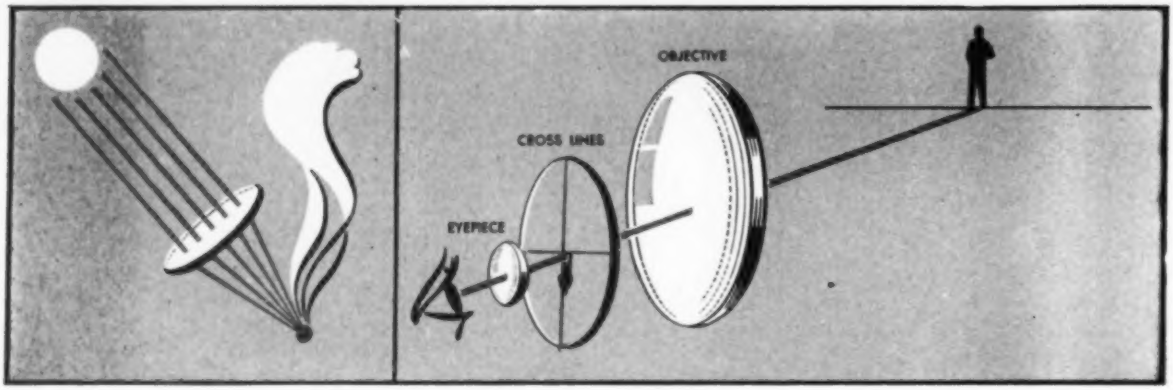
POSITIVE-ACTION CONTROL of span motors is centered in this G-E operator's desk. Fine-scale selsyn dial pinpoints position of each leaf during seating.

EACH LEAF IS MOVED by 2 G-E 25-hp motors (one shown). G-E motor control center, operated from desk, controls these and tail locks, gates, barriers.

Engineered Electrical Systems for Heavy Construction

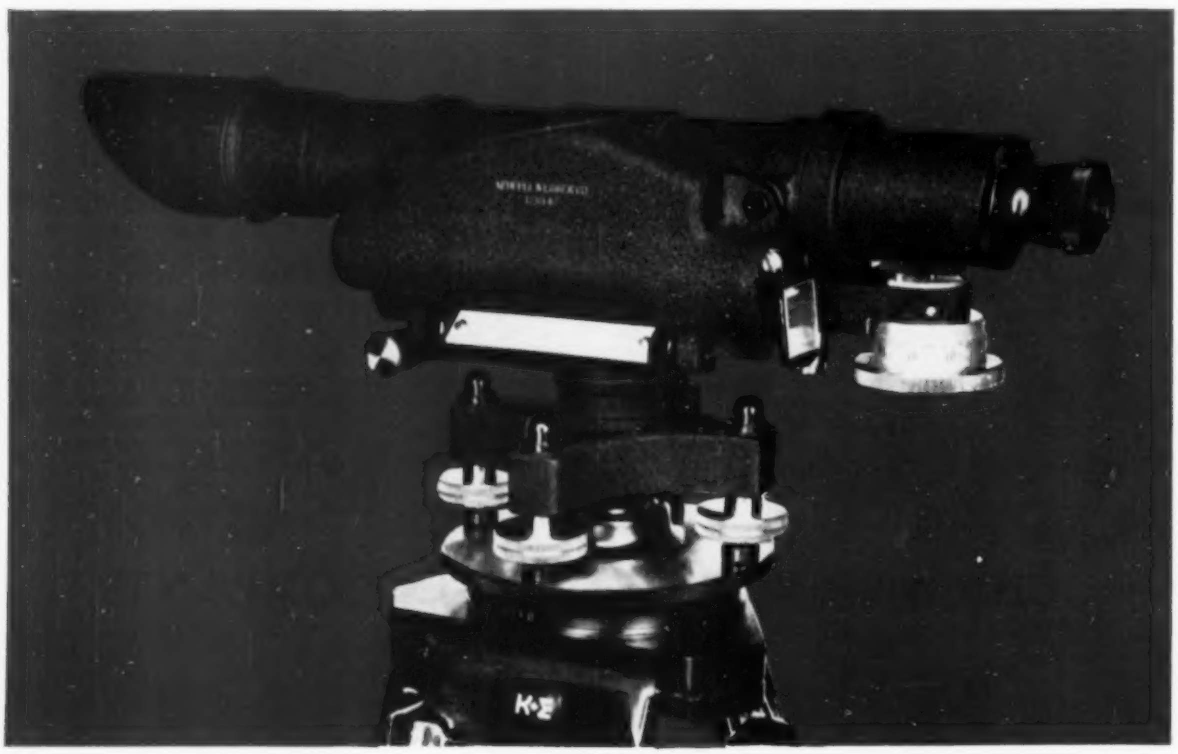
GENERAL ELECTRIC

How the image you see gets PARAGON

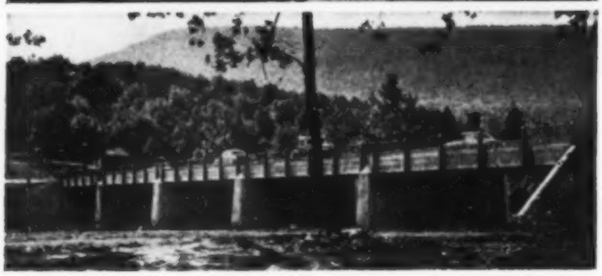


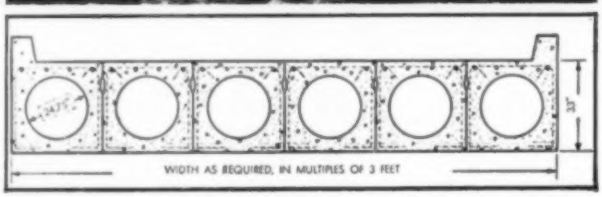
Even an ordinary reading glass can produce an image of sorts. That happens when the sun's rays are focused on a piece of paper as shown. All the rays passing through the lens concentrate at approximately one point where they form a small inverted picture or image of the sun.

By means of a lens, rays from any object at a distance can be made to concentrate inside a telescope in the same way. They form a tiny inverted picture of the object. If a screen like the ground glass of a camera were placed there and viewed through a magnifying glass, the actual picture of the distant object could be seen clearly. The lens that brings the tiny picture into a telescope is called the objective, and the small but powerful microscope that brings it out of the telescope into the eye is called the eyepiece.

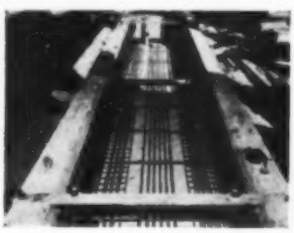


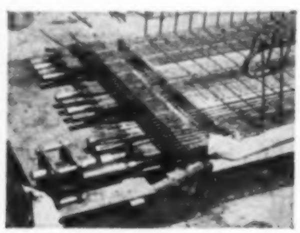
STRESSING the Advantages of PRESTRESSED Concrete





Typical cross-section of prestressed concrete bridge shows assembly of standard units 3 ft. wide. Top, views of Gleniron, Pa., Bridge. Below, anchorages for prestressing, spaced 120 ft. apart, have total capacity of 200 tons. Seven-strand steel cable, 0.25" diameter, is tensioned to 135,000 psi, in groups of ten. Using 'Incor', members are lifted 3-4 days sooner . . . maximum speed, minimum cost.





Prestressed, Precast Concrete Members Lifted 3-4 Days Sooner, using 'INCOR' 24-Hour Cement

● This 265′ prestressed, precast concrete bridge, with 25′4″ roadway, recently completed at Gleniron, Union County, by Pennsylvania Department of Highways—one of 73 bridges of this type, with clear spans up to 50′—consists of 45 prestressed members, each 53′ long, 3′ wide, 33″ deep, weighing 20 tons, produced by CONCRETE PRODUCTS COMPANY OF AMERICA with Air-entraining 'INCOR' Cement.

With 7 men and crane operator, MURPHY CONSTRUCTION COMPANY, Hummelstown, Pa., erected this bridge in less than a week. Cost: about 25% *less* than estimated for built-in-place reinforced concrete of conventional design.

Tensioning is usually applied when concrete attains 3500-4000 lbs. compressive strength. Dependable 'Incor' high early strength makes it easily possible to lift prestressed members 3-4 days sooner than with ordinary concrete. For high strengths, low water-ratio is necessary, and 'Incor' mixed with 4½ gal. water per bag of cement develops over 4000 lbs. in 48 hours.

COMPRESSIVE STRENGTH OF 'INCOR' CONCRETE

Max. Water Gal/bag	6 x 12-in. cylinders, cured moist at 70°F. Compressive Strength—p. s. i.					
	1 day	2 day	3 day	4 day	7 day	28 day
4½	3550	4550	5100	5450	6050	7000
5	3150	4050	4600	4950	5550	6450
5½	2750	3650	4150	4500	5050	5950

Dependable 'Incor'* high *ultimate* strength means that initial 'Incor' economies are matched by long-time durability and lowest annual cost—attested by over 25 years' performance of America's FIRST high early strength portland cement.

*Reg. U. S. Pat. Off.

LONE STAR CEMENTS COVER THE ENTIRE CONSTRUCTION FIELD

LONE STAR CEMENT CORPORATION

Offices: ABILENE, TEX. • ALBANY, N. Y. • BETHLEHEM, PA. • BIRMINGHAM
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KANSAS CITY, MO. • NEW ORLEANS • NEW YORK • NORFOLK
PHILADELPHIA • RICHMOND • ST. LOUIS • WASHINGTON, D. C.

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MARCH 1953

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• DEPARTMENTS

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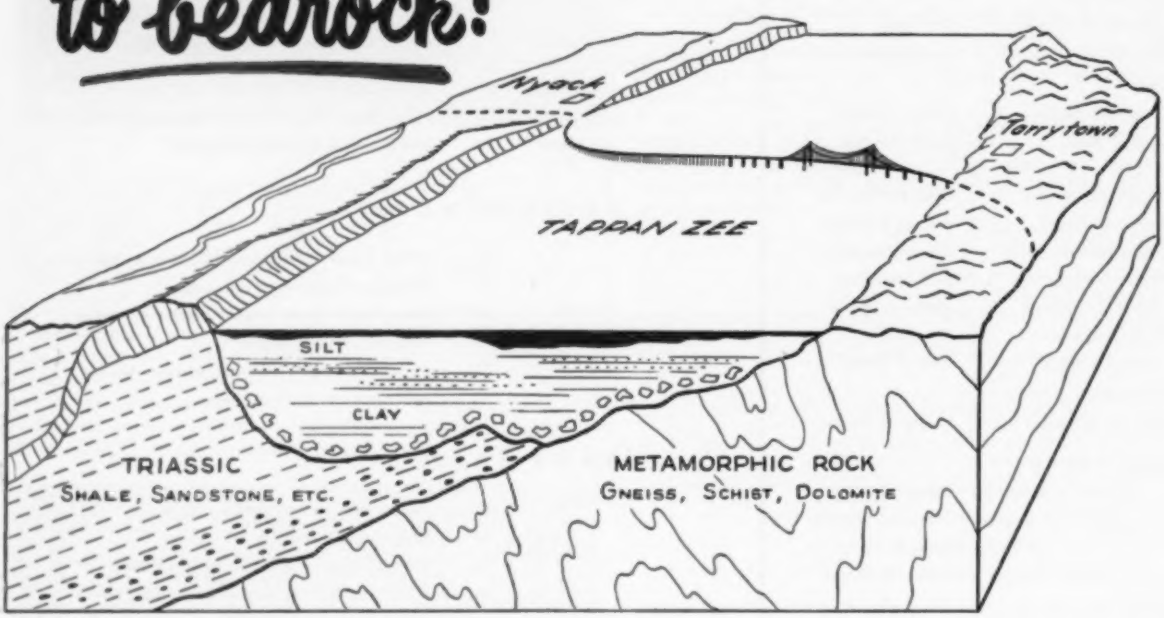

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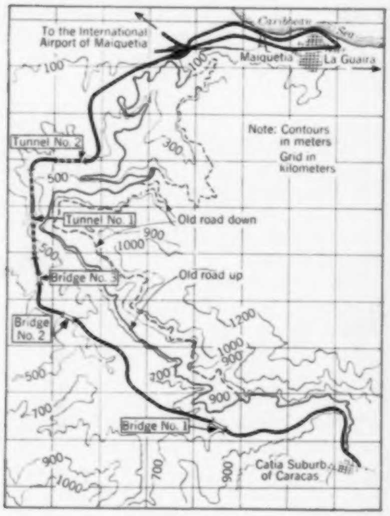
CIVIL ENGINEERING

MARCH 1953

THE MAGAZINE OF ENGINEERED CONSTRUCTION

FIG. 1. New highway connecting Caracas, capital of Venezuela, with its port of La Guaira and the airport at Maiquetia, cuts travel time by 75 percent.



Caracas-La Guaira highway climbs 3,000 ft through rugged Andean foothills in its 10.8-mile length. For every mile of highway, 3 miles of access roads had to be built. Route is called "most expensive highway in the world" because of its cost of around 6 million dollars per mile.

Venezuela builds new Caracas-La Guaira superhighway

HENRIQUE SIBLESZ

Dr. Ing.; Executive Director, Ministry of Public Works, Caracas, Venezuela

The new, 60-million-dollar Caracas-La Guaira highway in Venezuela is a far cry from the original wagon trail, built in 1837–1845, which wound its way up the steep Andean foothills from the seaport of La Guaira to the capital city of Caracas. See the accompanying map, Fig. 1. Even the present route, grown woefully inadequate with the expanding population and commerce of the area, is far surpassed by the new artery in speed and safety, cutting the travel time between the capital and its port by 75 percent and the distance almost in half. The new route includes the three largest prestressed concrete bridges in the world and two twin-

Large quantities of modern equipment were used in construction of Autopista. More than 115 tractors, scrapers, mechanical shovels and graders were used. In addition 100 Euclids and large dump trucks, 12 ready-mix trucks, sheepsfoot rollers and pneumatic rollers were used. Bridge No. 1, largest concrete arch in the Americas, can be seen in background.

bore tunnels, one of which is over a mile long. Four and six lanes wide, the Autopista, as it is known locally, climbs 3,000 ft in its 10.8 miles of length.

The present road was built when automobiles first made their appearance in Venezuela. This $18^1/_2$-mile road, of which approximately 90 percent is on curves, has the following characteristics: average width, 25 ft, with a minimum as low as 18 ft; maximum grade, 12 percent; and 395 curves with a minimum radius of about 49 ft. It is certainly not the sort of connection one would expect to handle the daily average of 6,000 cars and trucks carrying passengers and freight to and from these cities. Bad traffic congestion, particularly at the entrance to Caracas, often results.

Caracas has grown from 359,000 inhabitants in 1941 to 750,000 at the end of 1951. All the supplies for it, as well as nearly 50 percent of all Venezuelan imports, use the Caracas-La Guaira road. So does most of the traffic of passenger and freight to and from the International Airport of Maiquetia, which handles approximately 200 national and international flights daily. The coastal resorts of Macuto, Catia-La Mar and Naiguata, the only seaside resorts within a reasonable distance of Caracas, cannot be reached except by this same road.

If to this we add the fact that often, after heavy rainstorms, traffic on this road is interrupted by landslides, thus cutting off Caracas from its airport of Maiquetia and from its harbor of La Guaira, it will be evident that this situation could not be permitted to continue. The government had been aware of the problem for many years. Preliminary studies had been made, ending with reports of financial and construction feasibility. Determination of the general route and establishment of a cost estimate were the principal parts of these studies. Some time was spent on studies to determine whether the cost of such a project, estimated at that time at approximately \$50,000,000, should be met from the current budget or by outside financing repayable over a period of 10 years. Both solutions had their advocates, but the former was adopted. Finally, in 1950, after 6 years of studies, the order was given to start work.

From the economic studies of the project, it became apparent that this should be a toll highway. It was estimated that the earnings over a period of 20 years would be sufficient to pay maintenance and operating expenses, interest on cost, and enough over to repay the initial cost itself. Accordingly the Autopista was made a toll highway with access only at each end. This presented no problem since the highway crosses barren mountains in its entire length. Automatically controlled toll stations, located at both ends, will determine the classification and toll charges for each vehicle.

The new highway will cut driving time between Caracas and La Guaira to 15 min as compared with one hour on the present road. The new route will have 36 curves with a minimum

Nearly 1,000,000 cu yd of earth were moved for each mile of highway. Some cuts were deeper than 300 ft and some fills were as high as 150 ft.

radius of approximately 985 ft. The average grade will be 5 percent, with a maximum of 6 percent and a minimum of 3.5 percent in the tunnels. The average design speed is 50 mph.

The standard cross section of the Autopista, shown in Fig. 2, is a four-lane road providing two 24-ft roadways in each direction, with a 4-ft-wide central footpath. As the entire length of this highway is being built

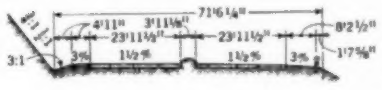


FIG. 2. Cross section shows typical dimensions of Autopista.

along steep mountain slopes, the roadway is provided on the mountain side with a 5-ft stabilized shoulder, supplemented by a 5-ft-wide drain, and on the other side with an 8-ft stabilized shoulder and a small wall acting as a parapet. The shoulders of the highway become an extra lane on the bridges, thus giving the bridges six traffic lanes, three on each side of the 4-ft-wide central island.

Traveling on this highway from its beginning, at Catia, a western suburb of Caracas, to its end in Maiquetia and La Guaira, various major structures are met in the following order (Fig. 1): at kilometer 4.2, bridge No. 1; at kilometer 8.5, bridge No. 2; at kilometer 9.7, bridge No. 3; at kilometer 11.2, tunnel No. 1; and at kilometer 13.1, tunnel No. 2.

The twin-bore tunnels are designed to compare favorably with the most modern structures of the same type built in other countries. They will be equipped with automatic carbon-monoxide control systems.

The three bridges are the largest prestressed concrete spans in the world and the largest concrete arches in the Americas. They were designed by Freyssinet and are being built according to his prestressing system.

Construction work on the superhighway started in 1950, from La Guaira towards Caracas. The first section, 2.5 miles long, called Avenida Central de Maiquetia, is now complete and open to traffic.

From this point, the superhighway starts climbing. It will cross the avenue which leads to the international airport of Maiquetia, and the highway to Catia-La Mar and be connected to them by a clover-leaf. After the clover-leaf, it continues towards Caracas.

Earthwork. The earthwork was started from both Caracas and Maiquetia. The size of the cuts and fills all along this new highway is impressive. The cuts have been made with slopes varying between $^1/_2$ and $^3/_4$ to 1, depending on the type of soil.

In all deep cuts—some are 300 ft deep—the side slopes are stepped back at every 60-ft depth by a bench 20 ft wide, paved and guttered with asphalt. The results of the geological studies proved indispensable in this work. The fills, the highest of which is 150 ft, have slopes of $1^1/_2$:1, consolidated.

The average amount of earth moved was about 1,000,000 cu yd per mile of highway, of which approximately 60 percent was rock.

Equipment. To carry out this work according to schedule, Venezuelan Government forces are using the most modern road building equipment available. More than 115 tractors, scrapers, mechanical shovels and graders are being used, together with more than 100 Euclids and large dump trucks, 12 ready-mix concrete trucks, sheepsfoot rollers, pneumatic rollers, and other items of highway construction equipment. Apart from this equipment, all belonging to the Venezuelan Ministry of Public Works, specialized equipment such as wagon-drills and compressors, belonging to the private company entrusted with the blasting work, is being used.

Culverts. Construction of the concrete culverts was started at the same time as the earthwork. The most important of the culverts are Quebrada de Tacagua, Quebrada Payot, Los Mangos, El Pauji, Las Canales, Las Veras, Las Palmas, and Las Paidas. The diameter of these structures varies between 5 and 17 ft, and they have a total length of 15,600 ft.

Stabilization of Slopes. Hardy shrubs indigenous to the area are being planted on the slopes to prevent erosion. To supply the required vegetation, two nurseries were set up, one at the lower end in Maiquetia, and the other at the upper end at Tacagua. These nurseries are capable of producing 670,000 shrubs annually.

(This article was prepared from the paper presented by Dr. Sibless before a Highway Division session, presided over by Francisco Pons, M. ASCE, at the Inter-American Convention of Civil Engineers in Puerto Rico.)

Autopista Compared with Existing Route

	Existing Route	New Autopista
Length	18.7 miles	10.8 miles
Width, av.	24.6 ft	70 ft
Maximum grade	12%	6%
Minimum radius of curves	49 ft	985 ft
Average permissible speed	16 mph	50 mph

Deep cuts were stepped back with 20-ft benches, paved and guttered with asphalt, at approximately every 60 ft of depth, as shown in photo at right. In photo below, special grass is being placed on slopes to prevent loose soil from being eroded.

Boqueron tunnels carry Autopista through Andean

RALPH SMILLIE, M. ASCE, Smillie & Griffin, Consulting Engineers, New York

Almost 1½ miles of the new 10.8-mile Caracas-La Guaira highway will be underground. The two structures which carry the ultra-modern Autopista through the Andean foothills are respectively 5,900 and 1,560 ft long. The longer tunnel, referred to as tunnel No. 1, is the southerly one and the northerly and shorter one is tunnel No. 2. Each tunnel has twin bores, each bore carrying two lanes of traffic.

Both tunnels are entirely in rock. They have a horseshoe section 28.7 ft wide between inside of vertical walls and 19.7 ft high from roadway to crown of intrados. The lining consists of reinforced concrete 2 ft thick. A concrete ceiling 14.1 ft above the roadway forms an air-duct space directly under the arch. The roadway wearing surface in the tunnels will be asphaltic concrete 3 in. thick, on a concrete base. Each of the two traffic lanes will be 12 ft wide with a 40-in. sidewalk on the right hand or slow-traffic side.

Ventilation Provisions

Fresh air will be introduced to the driving area of both tunnels from the air duct through ports in the tunnel ceiling. In general, vitiated air will go out the tunnel portals. At both portals of the longer tunnel, and at one portal of the shorter one, there will be reinforced concrete ventilation buildings, which will also form the tunnel portals. These buildings will house the ventilating fans and electrical equipment and also provide space for a wrecking truck.

Adjacent to the portal nearest to Caracas, there will be a control building with garage space for maintenance equipment and living quarters for the tunnel superintendent. A central control board for the supervisory control of both tunnels will also be located in this building. The board will provide for the remote control of all ventilating fans, and will have indicators to show the position of traffic signals, and carbon monoxide recorders showing air conditions in all tunnels. A local automatic telephone system will connect stations in the tunnels and all ventilation buildings with the central control room.

All tunnels are on a 3.5 percent grade. The up-grade bore of tunnel No. 1 is too long to be ventilated economically from the portals only. Fortunately a part of this tunnel runs near a precipitous sidewall of the gorge through which the highway passes, making it possible to drive two short horizontal drifts to the open air at about the third points of the up-grade tunnel. One drift is used for blower fans and the other for exhaust.

In general, there will be three fans on each duct section, two of which will provide normal maximum ventilation, so that any one fan can be shut down for overhaul.

Fans will be of the horizontal-vane axial type, with wheel diameters of 72 and 84 in. In the portal buildings and the blower drift, the fans will discharge directly into the tunnel air duct in the arch above the roadway. The fans in the exhaust drift will draw vitiated air from the roadway space.

To obtain the necessary variation in air quantities, all but two of the fans will have two speeds. The 72-in. fans will be driven by two-speed, two-winding, squirrel-cage, direct-connected motors mounted in the fan hub. The 84-in. fans will be driven by a direct-connected, externally mounted, wound-rotor motor for full speed, and for half speed by a squirrel-cage motor directly connected in tandem to the shaft of the high-speed motor. There will be a total of 24 fan units capable of delivering 3,328,800 cu ft of air per min.

Electrical energy for the tunnels will be supplied from high-tension, 50-cycle lines of the local power company. This will be stepped down to 4,800 v in two substations near the tunnel portals. Continuity of service is insured by three feeders passing through both tunnels with taps at the ventilation buildings and at the drifts.

Lighting is planned for the entire length of the highway. The tunnels will be lighted by continuous lines of fluorescent lamps located near the ceiling on the sidewalls. A unit includes two 6-ft lamps in series enclosed in a glass tube. Each unit will be contained in a bronze box which contains a transformer and is bolted to the tunnel sidewall. Lamp circuits will be in series, connected to the three feeders in such a way that failure of one source will put out only every third unit.

During daylight hours, lamps near the portals will burn at a greater intensity to compensate for the transition from daylight to artificial light in the tunnels. At night this intensity will be reduced to normal.

foothills

Boqueron Tunnels, on Venezuela's new superhighway, will carry four lanes of traffic when completed. Each bore of twin-bore structure carries two lanes. Artist's sketch shows completed portal of one of the two tunnels on route between Caracas and its port of La Guaira.

Lamps fed by storage batteries will be installed in the tunnel ceiling at intervals of 200 ft to give enough light to drive by in the event of total power failure.

Electric power for construction was generated by a diesel plant at the site of the work. Compressed air came from eight 500-cu ft portable air compressors. The methods used in tunnel construction are described in the following article by Edward D. Phinney.

Work on the tunnels started early in 1951. By the end of 1952 all excavation had been completed, tunnel No. 2 was lined, and the lining of tunnel No. 1 was more than half finished. Ventilation buildings are under construction.

The work is being carried out under the supervision of the Ministry of Public Works of the United States of Venezuela. Dr. Girardo Sanson, as Director, initiated the project. He has recently been followed by Dr. Louis E. Chataing. Dr. Henrique Siblesz, Director Administrator, is in charge of the entire project.

The Morrison-Knudsen Co. of Venezuela has the contract for tunnel excavation and lining. The ventilation buildings are being built by Cardone Associados S. A. of Caracas, and Dr. Herman Lange Ricardo, also of Caracas, has the contract for tunnel pavement.

Electrical equipment will be furnished by the Westinghouse International Co., and fans and motors by the Joy Manufacturing Co.

Smillie & Griffin, consulting engineers of New York, prepared the designs.

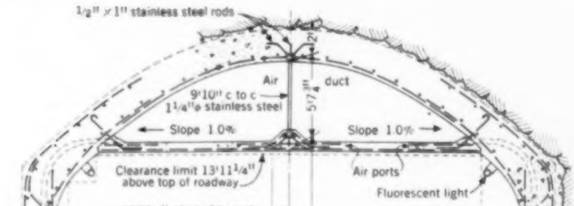


FIG. 2. Typical cross section of Boqueron Tunnels shows method of ceiling suspension. This particular cross section, called design "C", is designed for a load of 45 ft of rock over highest point of crown.

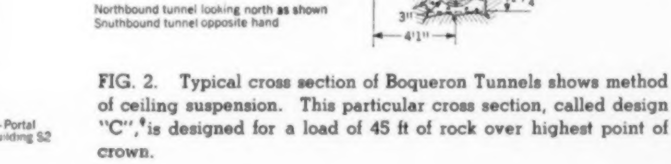


FIG. 1. Tunnel No. 1 on Autopista is 5,900 ft long. Tunnel No. 2, about one mile north of tunnel No. 1, is 1,560 ft long. Tunnels have horseshoe section about 29 ft wide by 20 ft high inside of lining.

Big equipment speeds construction of Boqueron Tunnels

E. DONALD PHINNEY, M. ASCE, Chief Engineer, C.A. Morrison-Knudsen of Venezuela

Because of the operations involved and the equipment to be used, the construction of the Boqueron Tunnels logically falls into five phases: (1) portal excavation, (2) tunnel excavation, (3) tunnel concreting, (4) grouting, and (5) miscellaneous structures within the tunnel limits.

The type of rock encountered on the excavation of tunnel No. 2, which was 1,560 ft long, was a laminated shale, very soft, and containing a great deal of mica. This rock was prone to slips and slides, several of which caused considerable damage to tunnel equipment.

In tunnel No. 1, just under 6,000 ft long, the rock was of many types, ranging from a laminated shale to a basalt interspersed with quartz lenses. This rock was very blocky, being criss-crossed with horizontal and vertical cracks, some water bearing. The water appeared at about the halfway point of this tunnel, and seemed to be trapped rather than to come from an underground stream.

In both tunnels the rock was such that roof support was required for the entire distance, the spacing varying from 1 to 8 ft on centers. The labor force was made up mostly of Venezuelans, supplemented by many different European nationalities. At the peak, more than 900 workers were on the payrolls.

Portal Excavation

Portal excavation began in February 1951 at the north portal of tunnel No. 2 and was completed at the north portal of tunnel No. 1 in August 1951. The quantities proved were as follow:

Tunnel No. 2, North Portal:
- Rock, 2,700 cu yd
- Earth, 24,300 cu yd

Tunnel No. 2, South Portal:
- Rock, 13,000 cu yd
- Earth, 73,000 cu yd

Tunnel No. 1, North Portal:
- Rock, 26,000 cu yd
- Earth, 26,000 cu yd

These figures are for excavation by Morrison-Knudsen, the remainder having been previously removed by government forces. Exact figures for these portals, therefore, are not available to the writer. The same is true for the south portal of tunnel No. 1.

Included among the equipment used in this excavation was one Marion 2½-cu yd diesel shovel, Model 93-M. The engine was a Caterpillar D-17,-000. A varying number of Koehring WD-60 Dumptors, powered with GM-4-71 diesels, were used with 12 units as a maximum at any one time. An average of 3 Euclid 10-cu yd rear-dump trucks, rented from a local agency, were also operated on this work at any one time.

Rock excavation was carried on at the north portal of tunnel No. 2 by jackhammers, using 500-cfm compressors, Ingersoll-Rand Model IKA-500, with International diesel engine, Model UD-24. Two of these machines were used here. At the south portal of tunnel No. 2, the rock excavation was sublet to a local outfit,

Tunnel heading was excavated in 5-hour cycle during which 5 ft of rock was pulled. Top platform of 13-drill jumbo mounted 3 Gardner-Denver hydraulic drills, Model JD-11, one of which is pictured with 136-in. offset boom and JCM hydraulic pump power unit.

Walls and arch were poured monolithically using Press-Weld, 1-cu yd, pneumatic placer. Use of 3 wall and arch forms permitted 1 pour per day with 48 hours to set before strippings.

Choice of the right equipment means much to the economical construction of an engineering project. The organization of this equipment into an efficient construction plant is reflected in the quality of the finished structure. Because the factors affecting this planning of equipment and plant are many and varied, experience weighs heavily. The following article records the procedure followed by Morrison-Knudsen in the construction of the Boqueron Tunnels on the Caracas-La Guaira Highway or Autopista. The design of these tunnels is discussed in the preceding article.

and the method used was to drill auger holes about 10 ft apart in both directions, and carry these holes to a point somewhat below the finished grade, and then shoot the entire volume with Milli-second delays. Approximately 14,000 lb of powder was used to shoot 16,900 cu yd of rock.

Tunnel Excavation

The excavation cycle in the tunnel was broken down into six operations. The average time of each cycle was five hours, during which the tunnel was advanced 5 ft. The operations and time allotted to each were as shown in Table I. Approximately about 125 to 140 holes were drilled per pull. In tunnel No. 2 the powder factor was 1.95 lb per cu yd and in tunnel No. 1 it was 3.26 lb per cu yd. The explosive was Hercules Gelamite No. 2, $1^1/_8$ in. by 8 in. Delay caps Nos. 0 to 10 were used.

The drilling jumbo mounted 13 drills. The drills were Gardner-Denver drifter-drills SF-73, size $2^3/_4$ with a 60-in. change, movable-cone aluminum-alloy guide, including a hole spotter for $1^1/_8$-in. round lugged shank steel. The jumbo had two platforms. The top platform carried three Gardner-Denver hydraulic-drill jumbos, Model JD-11, with an offset boom unit 136 in. long and a JCM hydraulic pump power unit. These top units provided sufficient maneuverability to reach all parts of the arch. The other ten machines were the conventional column-and-arm type.

TABLE I. Excavation cycle in tunnel

Operation	Time	Percent of Cycle
Drilling	1 hr 40 min.	34
Loading and shooting	20 min.	7
Ventilation	25 min.	8
Mucking (45 loads)	1 hr 20 min.	26
Lay track	20 min.	7
Erect support	55 min.	18
Total	5 hr 00 min.	100

The machine used to muck the heading was the Joy hard-rock loader, Model 18-HR-2, with a 75-hp 220/440-v, a-c, 60-cycle, 3-phase electric main drive, and two $7^1/_2$-hp conveyor motors, 220/440-v, a-c, 60-cycle, 3 phase. The loader had an extension conveyor for loading the WD-60 Dumptors.

One drill crew and one muck crew were used for two headings. In this way each crew could alternate between headings and keep busy during the entire shift.

Power and light for the tunnels was furnished by three skid-mounted Caterpillar D-386 diesel electric sets, of 2,400-v, 4-wire, 60-cycle, 3-phase, 1,200-rpm, 250-kw type.

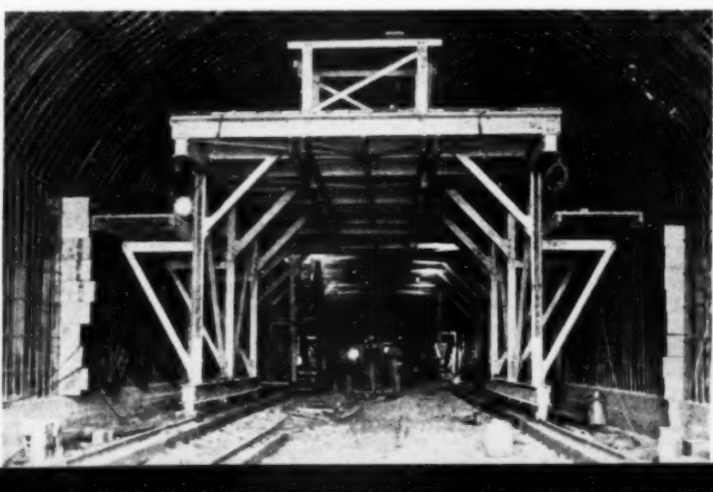
Power and light for the camp and the shop area were furnished by two skid-mounted Caterpillar D-17,000 diesel-electric sets, of 2,400 v, 3 phase, 60 cycle, 100 kw.

Ventilation in the tunnels was provided by Joy Axivane fans, Model 1,000-54-$26^1/_2$-17, with a 75-hp, 440-v, 3-phase, 60-cycle, a-c motor.

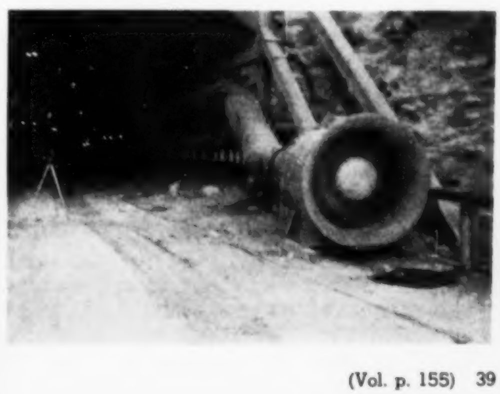
During the perforation of tunnel No. 2, one of these fans was used in each tube, and the air was conducted to the face by a DuPont No. 1 flexible vent-tube. In tunnel No. 1, the ventilation presented a special problem, and the mine system of ventilation was used.

Two ventilation tunnels were driven out through the sides of the mountain, to house ventilation equipment. Use was made of these tunnels to provide temporary ventilation during excavation of tunnel No. 1, after the location of the ventilation drifts was passed. Cross passage No. 1 between tunnels was utilized in this ventilation setup. A bulkhead was constructed at the entrance to the ventilation tunnel and in it was mounted a series of three Joy Axivane fans. Additional bulkheads were built across both tunnels to

Specially designed platform was constructed to facilitate placement of reinforcing bars. Horizontally mounted pipe with welded lugs to mark spacing of reinforcing bars permitted use of unskilled labor in placing of reinforcement.



Ventilation of tunnel during excavation cycle was provided by Joy Axivane fan, Model 1,000-54-$26^1/_2$-17. During perforation of the heading for tunnel No. 2, one fan was used in each tube. Air was conducted to the face by a DuPont No. 1 flexible vent-tube.



direct the flow of air from the drift through the cross passage and up the left-hand or northbound tunnel. At the next cross passage, two more fans were mounted, one in each tunnel. These fans picked up the air and carried it to the face through the same type of tubing used in tunnel No. 2. The main current of air then passed back down the southbound tunnel and was directed out through the second ventilation drift by means of a bulkhead built across the southbound tunnel between the two drifts.

Considerable experimentation with drill bits led to the exclusive use of removable bits. These included carbide insert bits and "throwaway" or one-use bits. Both were satisfactory, although the carbide insert bits were not economically advantageous.

The roof supports were designed to carry a rock load 10 ft in depth at 5-ft spacing. The posts were 8 WF 31.0 and the arch ribs were 8 WF 40.0. Each bent was made up of two posts and two arch ribs. However, because of delays in delivery of the steel, it was necessary to use 12 × 12-in. timbers with a 7-segment arch for about 400 ft of tunnel No. 2. Timber collar braces and timber lagging were used throughout. The collar braces were removed before concrete operations began as these were inside the net line. All other timber blocking and lagging was left in place. Roof support posts were set on a foot block which was chipped into the tunnel floor to give additional anchorage against lateral movement, and $^3/_4$-in. tie-rods were used to fasten the sets together.

Concreting the Tunnel

Concreting was broken down into three operations—the footings, the sidewalls and arch, and the roadway ceiling. The footings were poured in 33-ft sections using the alternate block method of pouring. The forms were made of steel, and enough forms were purchased to permit three 33-ft sections on each side of the tunnel to be poured daily. Embedded in these footings were Richmond Screw Anchor springs which fastened the wall and arch form to the footings to avoid lateral movement while pouring. The forms were fastened to the roof-support posts by special clips and clamps, adjustable to allow for any irregularity in the alignment of the posts. An innovation was the construction of a 1-ft by 6-in. pad at the bottom of the footing, below net line, which was poured with the footings and served as a runway on which the reinforcing jumbo, the concrete work platforms, and the trimming jumbo could travel, thus eliminating rails for these items and leaving the rails to be used only for those platforms and form travelers which passed under the previously poured forms.

The forms were moved by stripping an entire 33-ft section at once, and loading it on a truck to be carried to the next section to be poured. Concrete was poured by transit mixers, which were Rex Hi-Discharge mixers of $4^1/_2$-cu yd capacity, mounted on a 10-wheel International chassis. Six of these trucks were purchased.

The reinforcing steel presented a special problem, and was erected on a specially-designed platform. This platform contained five sets of horizontally mounted pipe sections, supported by five sets of rachet jacks. The spacing of the reinforcing steel was marked off on the pipe sections by means of lugs welded on the pipe. Thus skilled operators were not required for placing the reinforcing bars, once the jumbo was started. When the complete reinforcing mat was set, the jacks pushed it up against the roof support, where it was tied. This was necessary to permit the concrete shooting line to pass under the reinforcing steel on entering the form. Just before a form was to be poured, the mat of reinforcing bars was cut loose, and fell into place the proper distance above the form. The reinforcing steel on the ceiling form was set in a conventional manner, and presented no problems.

The walls and arch were poured monolithically using a 1-cu yd Press-Weld pneumatic placer. One of these guns was mounted on each side of the tunnel, suspended on a specially designed platform or series of platforms, which were tied together and were movable, so that the whole assembly could be moved ahead as the form filled up.

Three wall and arch forms, of telescopic type, were purchased, permitting a form a day to be poured and allowing the concrete to set 48 hours before stripping. The schedule of wall and arch concreting was to set the form in the 8-to-4 day shift, pour the concrete in the 4-to-12 shift, and strip, clean and move the form in the 12-to-8 shift. This system has worked well, and since operations were started, on February 26, 1952, not a pour has been missed.

The concrete is conducted to the forms through 6-in. shooting lines. The bends are made of Goodall Rubber Co. concrete-placing hose using two pieces per shooting line, one at the Press-Weld gun and the other at the top of the line to change the direction of flow to horizontal for passage into the form. A prefabricated steel bulkhead at the end was designed to fit inside the roof support, with the remaining distance to the rock being filled with wooden bulkhead sections. In order to negotiate the curves in the long tunnel, special curve fillers were designed for all the forms, and these were used successfully on the spirals as well as on the regular circular sections.

The ceiling forms were poured by a Model 160 Rex Pumpcrete machine with 6-in. Pumpcrete pipe. This form was also telescopic, and four sections were provided, thus permitting each form to remain in place for 72 hours before stripping. Both the ceiling and the wall and arch forms were supported on the bottom by the concrete pad previously mentioned.

The wall and arch form was moved by a traveler equipped with power-operated hydraulic jacks mounted at each corner. Collapse of the form was effected by rachet jacks mounted on the traveler and engaging special brackets on the side of the form just below the hinge.

The ceiling-form traveler, because of its light weight, was raised and lowered by hand-operated hydraulic jacks, also mounted in the corners. Eight jacks moved the wall and arch form; four moved the ceiling form.

Quantities of concrete poured in each type of form are as follows: The footings, one section on both sides of the tunnel, took 9.3 cu yd. A wall and arch section took 152.7 cu yd, and a ceiling form took 14.0 cu yd. A 1:2 grout mix was used at the start of each pour.

Grouting Procedure

Grout was placed by a 4-in. by 10-in. double-acting high-pressure grout pump. Approximately 100 pipe nipples and plug cocks were screwed into the grout pipes which had been set in the forms before concreting operations began. These pipes were placed to take advantage of the natural rock contour. The grout was pumped into the high pipes, and when the low pipes bled they were turned off in succession, until the section was full. A 1:2 grout mix was used throughout the work. A special agitator tank was designed, large enough to hold a truck load of grout, and this permitted the use of two transit-mix trucks to keep the operation supplied with grout.

A drainage ditch containing a 24-in. reinforced concrete pipe, and manholes and catchbasins, with con-

(Continued on page 98)

Largest concrete spans of the Americas

Three monumental bridges built in Venezuela

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Venezuela's new highway now under construction between La Guaira airport and Caracas, the capital, is being built along a gorge which it crosses three times on relatively large bridges designed and constructed by the Entreprises Campenon Bernard using my methods and under my direction.

In the gorges that had to be bridged the ground is crumbly and rises on slopes as steep as 45 deg. The vertical distances between the bottom of the ravine and the roadway are 230, 240 and 170 ft, respectively. This type of ravine is ideal for the use of the large hollow-box type of concrete arch which has become classical since the construction of the bridges at St. Pierre-de-Vauvray and Plougastel in France.

In fact, the largest of the three bridges on the Caracas highway has dimensions approaching those of the arches in the Plougastel bridge, and the two others are almost exactly like it except that they are slightly shorter in span.

An examination, however, reveals that there are important differences between the Venezuelan arches and those at Plougastel due to the differences in the requirements and the sites. First, the Venezuelan bridges carry a lighter live load (since the arches at Plougastel were designed so that eventually a normal-gage railway could be placed under the roadway) and have a greater roadway width. This led to a design with three parallel arch ribs, separated by spaces wider than the ribs themselves. Besides this, the arches at Plougastel were fixed at their supports, an arrangement made possible by the ground conditions, which permitted foundations having a rigidity much greater than that of the arches—a condition necessary for the effective use of fixed supports to increase the resistance of the arches to live loads.

In Caracas, preliminary information concerning ground conditions indicated that good soil would be found only at irregular depths, probably fairly great. Under these circumstances, the construction of abutments capable of resisting large bending moments could become difficult, if not impossible. It was therefore considered prudent to require that the abutments resist only the centered thrusts of the arches, and to reduce the bending moments applied to the abutments practically to zero. This condition made it necessary to locate the hinges of the arches as near as possible to their points of origin.

In 1910, I developed a type of hinge which consists essentially of a concrete cushion made perfectly plastic by suitable transverse reinforcement. (See *Annales des Ponts et Chaussées*, March-April, 1923.) At Boutiron, near Vichy, in 1912, I applied it to some arches whose intrados radius of curvature is nearly the same as that of the Plougastel arches (about 430 ft); and later to the 207-ft Candelier arch over the Sambre and to many arches of lesser importance. In these bridges the thrust transmitted by the hinge connections was more than 240 tons per lin ft of hinge.

How Many Hinges?

At this point a very important question arose. Should two or three hinges be used? I am well aware of the preference of the theorists in this case. A designer sitting in his office will always choose the three-hinged arch under the pretext that it eliminates the parasitic stresses developed by the thermohygrometric variations, that is to say, variations in temperature and moisture content of the concrete.

As a young engineer freshly graduated, I also had accepted this solution for the bridge at Veurdre. I did not then dare think otherwise than my tutors, and was unaware of two essential truths: first, that universal acceptance of an idea or principle does

not constitute proof of its validity, and second, that in taking responsibility for an unusual work, the designer assumes the sacred duty, both to himself and to the public, of doubting everything he has not himself verified regarding the fundamental properties of the materials he proposes to use, under the conditions and in the form in which he proposes to use them.

Having accepted without verification the opinion of the masters of the era on the subject of deformations in concrete, I saw my arches at Veurdre, objects of so much love and care, and of which I was so proud, develop progressively, after construction, curvatures which increased their stresses to such an extent that collapse seemed inevitable. In this crisis I took two audacious steps which saved the bridge. First, my striking jacks were inserted at the crown to correct the dangerous deformations, and second, the crown hinge, which was responsible for the instability of the arches, was eliminated.

This experience gave me the strongest reasons to distrust statically determinate arches in concrete. To add the stresses due to thermohygrometric variations or other changes in dimensions of any origin, to those due to loads, is one of those absurdities which too often results from the mania of the theorists for oversimplification. The reasons invoked by the theorists to justify the design of three-hinged arches have no validity whatsoever.

To determine the stresses to which the arches are subjected, include: (1) the thermic and hygrometric coefficients, which frequently work opposite to one another (and whose importance is greatly exaggerated when they are considered separately); and (2) the modulus of elasticity of the concrete. Now, this modulus decreases considerably as soon as the total stresses approach dangerous limits, so that however high the calculated values are, the deformation stresses never endanger well-designed structures possessing in every part, as should be the case, a margin of safety more or less constant. Even though it creates difficulties for those who manufacture formulas, the fact that concrete is endowed with faculties of self-healing and of defense against local additions of stress, must never be lost sight of.

The risk of buckling, on the contrary, is particularly real. The possible variations of the modulus of elasticity of concrete here operate in a direction opposite to that of the preceding case because the lower the modulus the greater the risk of buckling. After a long loading period, the deformation due to creep may be more than four times greater than the instantaneous deformation, which, from the point of view of the study of buckling under permanent or frequently repeated loads, obliges us to consider a Young's modulus of 1,500,000 psi for concrete of high quality and lower for mediocre concretes.

In the case of the Caracas bridges, these considerations led to the omission of the crown hinges, which had been included in the preliminary studies for ease of presentation. This decision was confirmed by a consideration of the consequences of possible movement of the abutments, such as might be caused, for example, by an earthquake. In such a case, I believe that there would be less damage to an arch having only two hinges.

Once the problem of the number and location of the hinges was settled, only two more important decisions remained to be made—the means of resisting the wind, and the form of the spandrel viaducts supporting the roadway. The depth of the hollow arch rib is that required to resist buckling, and the thickness of the concrete in top and bottom elements of the hollow box rib is determined by computing the bending moments.

I shall leave to Mr. Muller the task of describing and justifying the means we adopted to resist wind pressure on the arch and deck. He will also describe how the irregularities of the neutral axis, of the moment of inertia, and of the stresses at the point of intersection of the arch with the deck, were reduced to a minimum.

Spandrel Column Spacing Determined

There is no rule to determine the number and position of the spandrel columns between arch and deck.

Plougastel Bridge, (left and below), designed by Eugène Freyssinet and completed in 1930, includes three hingeless, single-rib, hollow-box arch spans of 604 ft each. This designer has proposed concrete arch spans up to 3,300 ft to be built by using cantilevered formwork.

←

First of three nearly identical bridges on Caracas–La Guaira Superhighway, Venezuela, was practically complete on December 30, 1952. Span of three hollow-box arch ribs of this six-lane bridge is 498 ft; rise, 108 ft.

The spacing of the columns is less than $^1/_{25}$ of the span at Villeneuve-sur-Lot and greater than $^1/_{10}$ of the span at Plougastel, but in both bridges the proportions are satisfactory. The composition of these elements, the pattern of the solids and open spaces, the manner in which the deck and arch are joined together—all these are, more than anything else, expressions of the engineer's own feeling.

From the point of view of economy in concrete quantities, it is advantageous to space the columns carrying the roadway as widely as possible. Because their cross section is mainly proportionate to their height, their spacing does not greatly influence their cost. The use of a wide spacing, however, gives the arches a rather unusual shape in order, on the one hand to maintain a uniform curve for the intrados, which is preferable from the esthetic point of view, and on the other hand to obtain a centroid adapted to the non-continuous distribution of loads. If some would judge this refinement unnecessary because of the existence of an ample margin of safety, I will remind them that a margin of safety is adopted to guard against the unforeseeable, not to remedy the known consequences of laziness or lack of integrity on the part of the designer. If the designer judges the margin of safety to be excessive, he should reduce it, but he should do it openly and thereby realize an economy in materials. He has no right to do it by a deception or because he has a faulty conception of the project.

The greater the scale of the job the more it becomes necessary to pay particular attention to the regularity and the uniformity of the margins of safety. The non-specialist may believe that a 1,000-ft bridge can be designed simply by adding a zero to the right on the dimensions for the design of a 100-ft bridge. In reality there is a very good chance that a project so calculated would be bad. When the scale of an arch is multiplied by 10, the stresses are also multiplied by 10 and the deformations are multiplied by 100. Such details, acceptable in a small arch, would be very ugly in an arch 10 times larger.

For these reasons the smallest details in a large bridge must be minutely verified from all points of view.

Light Cantilever-Type Falsework Adopted

It is not in the design of the shapes that the real difficulties of these arches lie, but in their construction. In 1920, in connection with the Villeneuve-sur-Lot bridge, I demonstrated the feasibility of an arch of 2,600-ft span. In 1930 I projected an arch of 3,300-ft span. However, nearly 15 years elapsed between the completion of the arches at Plougastel and those at Sando, and the gain in span was less than 50 per cent. This is evidence that the real difficulty lies in the erection of the falsework which enables the arch to be built.

The Caracas bridges, hardly comparable in span to the bridge at Plougastel and smaller than several other arches built in Europe, nevertheless do break a record—in difficulty of construction. Actually, the great height of the Caracas arches above the gorges, the uneven and crumbling nature of the ground, and the fact that the sites are exposed to the cyclones of the Antilles, make it practically impossible to use scaffolding supported directly on the ground. For the same reasons, it was impracticable to erect a falsework comparable to that used for any other long-span arch in the world.

One could conceive of an arch falsework prefabricated in three parts, with two of the parts erected by rotating them on hinges at the abutments and the third raised by supporting it on the other two. But the construction and erection of such timber elements would have been too expensive.

These difficulties led me to progress from this conception to the idea of erecting the concrete arch ribs by a cantilever method in precast sections, using falsework only in the area of the crown. For fear of alarming government authorities by too new an idea, the contractor proposed a steel trussed-arch falsework. I did not advise its use and formally declined responsibility for it. Built in such a manner as to give the necessary safety, a steel falsework would have been prohibi-

tive in cost. After a series of studies the designing office of Enterprises Campenon Bernard also concluded that the cantilever method was most desirable.

However, I gave up the erection of precast concrete parts by the cantilever method because it would require very powerful lifting tackle, impossible to secure within the time limit accepted by the contractor. Instead I decided to erect the timber formwork by the cantilever method. Such forms could be put in place with an overhead cableway, and held by anchor cables. After the concrete had been placed and had hardened, other similar elements could be constructed, thus completing the bottom layer of the box arch out to points situated about $^3/_4$ of the height and $^1/_4$ of the span from each abutment. Using these points of support, a falsework formed by a very light wooden trussed arch, tied by cables while being lifted, could be raised and placed in a single operation between the two cantilever arms already in position. This falsework, weighing only 220 tons, or 1,650 lb per lin ft, was lifted by four eight-sheave tackles, operated by four electric winches. At the joints of the falsework the timbers were connected by nailed plywood gussets and concrete was packed between the ends of the timbers. This falsework, wedged against the arch sections already erected, to which it transmits its thrusts, worked as an arch under the weight of the bottom chord which, at later stages, operated together with the falsework to carry the webs and top chord of the hollow arch ribs when they were placed.

This method offers two great advantages: (1) it is very economical because it reduces considerably the quantity of timber required for the construction of the falsework; and (2) it gives absolute safety against wind gusts during building.

The Caracas bridges can therefore be considered as models on a small scale of the 3,300-ft arch which I described in 1930 before the French Society of Civil Engineers. There is no obstacle to changing the scale of the methods of execution.

This is the first application of cantilever methods to the construction of very lightly reinforced concrete arches of unlimited span by relatively cheap methods. For longer spans than those at Caracas the cantilevers could be lengthened by constructing higher piers and strengthening cables and anchorages. A central arched falsework of 1,000 or 1,200-ft span could be designed simply by changing the scale of that used at Plougastel. The stresses in the cantilevered parts, under the dead load of the central falsework only, were less than 150 psi. They would therefore not exceed 400 psi for an arch falsework of the same shape but two and a half times larger.

Timid contractors will object that the application of such a method demands the most detailed planning to provide for all the stresses and deformations which occur during all phases of concreting. They would say that the least error could be fatal. This is perfectly true—and I will add that a study of all the cables, all the members, and particularly all the connections, must be made with the most exacting and rigorous technical integrity. Whoever thinks it is possible to build an exceptional structure without possessing and utilizing this quality to a very high degree will inevitably end up with catastrophies.

Actually, the plans for the construction of the Caracas bridges were drawn up in Paris by a team of very young engineers who, with the exception of Decharne, my trusted collaborator for more than 40 years, had had no experience with such work, and the bridges were built at Caracas by another team not one member of whom had ever taken part in the construction of such a large bridge, and not one of them ever felt the need for an explanation of any point whatsoever connected with the design. Such accuracy and forethought were achieved because I recognized in the team of young collaborators with whom Campenon Bernard surrounded me, the same qualities that had inspired me when I was their age—ambition, absorbing interest, and pride in their profession. They were actuated by an ambition to broaden their capacity to solve difficult problems, a demanding technical integrity, and an enthusiasm shorn of vanity.

These young engineers in Paris went over all the details of the project and verified them thoroughly; and those in Caracas carried out the plans with minute exactness. One bridge has already been finished without incident. I confidently expect that the same will be true for the other two, although no one knows better than I that risks are inherent in every enterprise no matter what precautions are taken, since human beings are always fallible and nature is full of the unexpected.

By way of conclusion I wish to thank the head of the team entrusted with the design, Jean Muller, and the head of the team entrusted with the construction, Robert Shama, M. ASCE, and all their collaborators, for having given an old man the illusion of still being able to create original works and thus of still being useful to humanity—thanks to their work, to their devotion, and to their faith.

Formwork for two-hinged hollow-box arch ribs of Caracas spans was designed to require minimum of lumber and to present minimum exposure to tropical winds. Erected by overhead cableway, forms were cantilevered out to quarter point of arch and tied back by cables. On these forms, bottom, sides and top of arch-rib box were placed in that order. Next, light wooden falsework for central half of span was hoisted into position, and remainder of rib concrete was placed.

Largest concrete spans of the Americas

How the three bridges were designed

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Since the design of the first bridge on Venezuela's Autopista required over three hundred drawings and some eight hundred pages of final computations, it is understandable that a detailed description of each element and its design cannot be given within the scope of this article, which will be confined to a summary analysis of the principal design problems encountered on the project.

The three bridges, although they differ considerably in length, are actually similar in appearance. The profiles of the valleys over which they carry the roadway made it possible to use the same basic design. The main part of the structure consists in each case of a double-hinged arch with a span varying from 450 to 500 ft. Approaches to the main span consist of a variable number of continuous beams of similar span and method of construction. The principal dimensions of the three structures are given in Table I.

The three bridges have an overall width of 70 ft, carrying a six-lane divided pavement. The central island is 4 ft wide, and each 30-ft roadway is curbed by a 2-ft 4-in. sidewalk. A transverse slope of 1.5 percent is provided for drainage, obtained by varying the thickness of the concrete pavement from 2 in. on the sides to $7^1/_2$ in. at the center. All bridges are designed for the AASHO H20-44 loading.

TABLE I. Three arch bridges under construction on Venezuela's Autopista

	Total Length	Height from Bed of Gorge	Main Span
Bridge No. 1	1,013 ft	230 ft	498 ft
Bridge No. 2	830 ft	240 ft	478 ft
Bridge No. 3	700 ft	170 ft	453 ft

To keep to a minimum the amount of design involved, and also to use precasting and prefabrication to maximum efficiency, standardization of elements for the three bridges was adopted whenever possible. A longitudinal section of bridge No. 1 is given in Fig. 1. The three bridges have the following features in common:

Each span of the deck consists of eight precast girders, having a cross section of the dimensions shown in Fig. 2. Variations in length are obtained by removing or adding standard form panels. Identical precast slabs, prestressed transversely, fill the space between girders.

Longitudinal cables placed in grooves over the top flange of the girders provide for continuity of the different spans.

Piers in the approach trestles, and spandrel columns over the arches, consist of three elementary I-shaped columns using

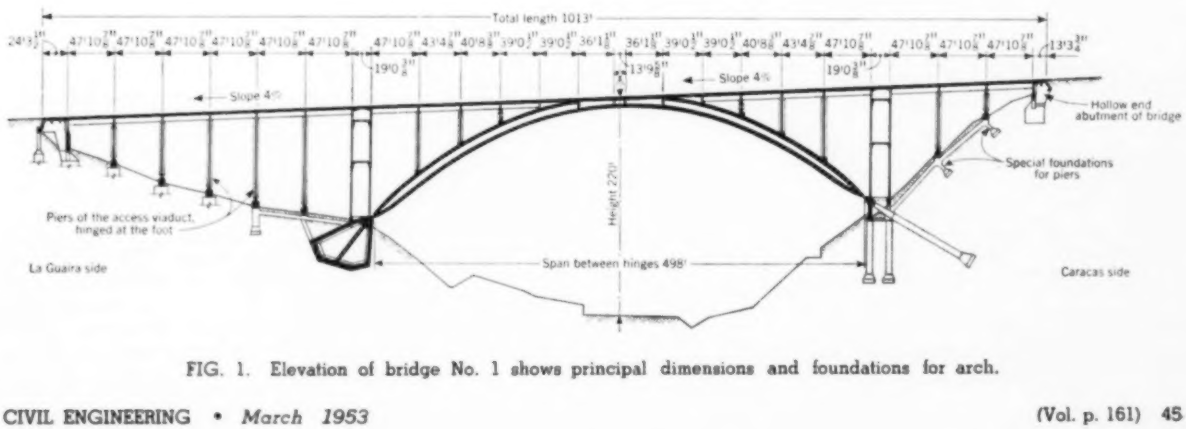


FIG. 1. Elevation of bridge No. 1 shows principal dimensions and foundations for arch.

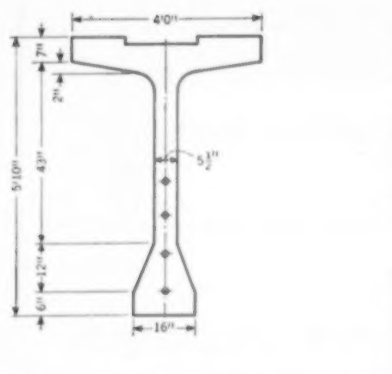


FIG. 2. Precast prestressed deck beams have same section for all three bridges.

the same typical section. Over these columns, a cross beam, precast in five units, receives the girders. A perspective view of the deck over a typical pier is given in Fig. 3.

Main arches have the same cross sections and nearly the same longitudinal shape (Fig. 4). The variation in span is obtained by changing the springings.

The shape of the arches being very similar, the same falsework elements are used for each bridge.

In bridge No. 1, pilasters have been placed at each side of the arch to create a major architectural feature, avoiding the unpleasant appearance of a change without transition from the main structure to the approach viaducts. Despite their thin hollow shell type, they have high bending and torsion strengths which provide resistance against wind loads and play a major role in stabilizing the whole structure.

The center span consists of three parallel double-hinged arch ribs of a hollow-box type placed 27 ft 6 in. on centers. Each arch rib is 10 ft 6 in. wide and varies slightly in depth from 9 ft 6 in. to 10 ft 0 in. at the supporting points of the deck. At the springing line, the width is broadened to 17 ft 0 in. to give the arches increased capacity to resist end-moments developed by horizontal loads. The 5 × 5-in. fillets at each inside corner are provided to reduce the concentration of torsion stresses.

The thickness of the bottom chord was reduced to the minimum to keep down the weight on the falsework, while the thick top chord provides the rib with the necessary area and moment of inertia for carrying the thrust and live-load moments.

The deck loads are applied to the arch at concentrated points by three spandrel columns on each side of the crown. The pressure line under the dead load consists, therefore, of a polygonal line and not a smooth curve. It was advantageous to follow as closely as possible the trajectory of this pressure line with the location of the neutral axis of the arch to minimize the bending moments and shear forces. This has been achieved by using a smoothly curved intrados line and a polygonally shaped extrados line, the summits of which are located at the points where the spandrel columns rest on the arch. An unpleasant appearance was avoided by chamfering the extrados on each side to give the appearance of a curved rib of constant depth throughout its length.

Because the viaduct is built on a uniform longitudinal slope, the lower half of the arch is longer than the upper, and the weights are unsymmetrically distributed. It was therefore necessary to use different locations of the neutral axis for each side of the arch. It should be emphasized that computations for the effect of deal load on the arch must be carried out carefully and accurately; an error of 1 in. in the location of the pressure line, which can be caused by neglecting a load of a few tons at the crown, changes the stresses in the arch by 3 percent.

The three arch ribs have no transverse bracing, except the three diaphrams which connect these ribs on each side of the crown, leaving a transversely unsupported length of 190 ft. However, an even distribution of unsymmetrical live load between the

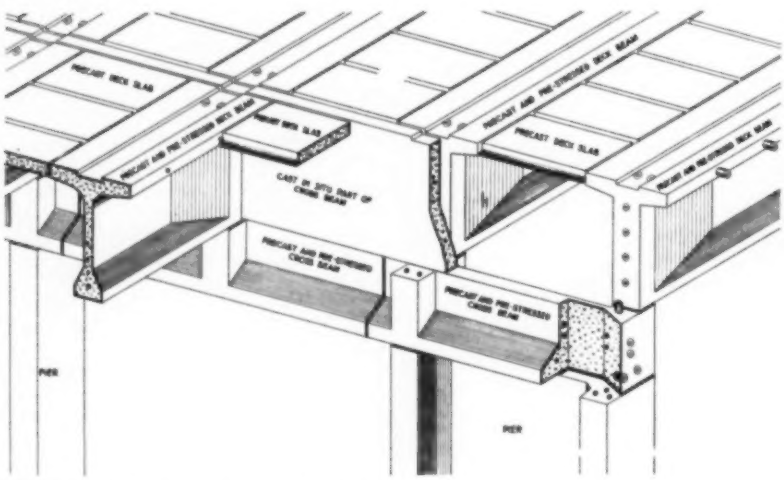


FIG. 3. Precast beams and slabs are placed on cast-in-place piers and assembled by vertical, transverse and horizontal prestressing cables.

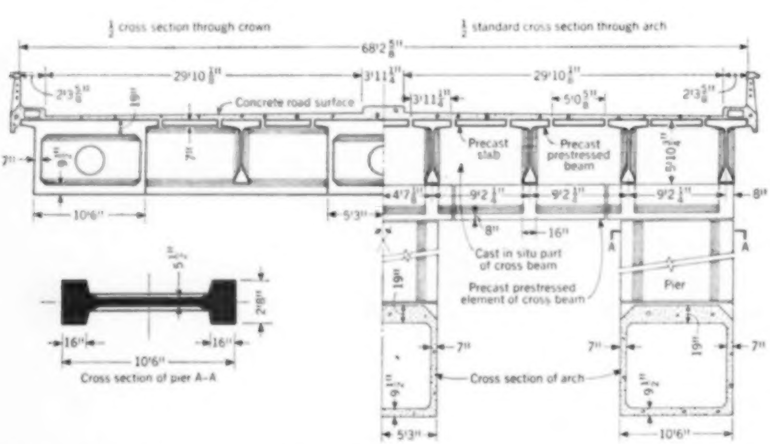


FIG. 4. Three identical main-arch ribs support spandrel-column piers and same type deck as in approaches.

three arch ribs is obtained by placing the pressure line of the arch high at the crown, almost at the level of the deck slab, thus using this slab as a diaphragm equalizing perfectly the horizontal deflections of the individual arch ribs. In this way the differences in distribution of live load to the ribs are decreased by approximately one-quarter. The result is that, because of this eccentricity of the pressure line at the crown section, tensile stresses will appear at the bottom flange. These are taken care of by prestressing cables stressed after the crown joint has been mortar-packed and all adjustments completed. This additional prestressing does not appreciably alter the location of the pressure curve.

It will be brought out later that the deck over the whole bridge had to be continuous throughout its length. This condition led us to attach the deck to the arch on both sides of the crown, by prestressing the continuous cables provided over the top flange of the girders and anchoring them into the arch itself. Six girders were connected to the three arch ribs in this manner; the two intermediate girders not resting directly on the arch were lengthened up to the crown.

An open joint was provided at the arch crown throughout the construction of the structure. Flat jacks staggered with concrete wedges were placed in this joint, acting like a third hinge for the arches, to adjust the pressure line to its most efficient location during the different phases of construction.

Continuous Deck Carries Wind Loads

The possibility of storms occurring in these deep gorges dictated the use of a design wind pressure of 50 psf. The same wind load was used for designing all elements of the falsework. The problem of transmitting such high wind loads, acting on both the deck and the arch, to the ground was a major one and governed many features of the whole structure. The wide six-lane deck carrying the roadway was obviously adequate for use as a stiff horizontal diaphragm for this purpose. The supports of this diaphragm consist of the abutments at the ends of the bridge, which provide fixed bearing points, and the two pilasters, one at each end of the arch proper, which contribute elastic support and an additional restraint to rotation of the diaphragm through the high torsional strength of the system.

The arch ribs carry only part of the wind pressure to which they are directly subjected, the remainder being transmitted to the deck by the bending of the spandrel columns and by the connection at the crown. The arches were assumed to be transversely fixed in the foundations, the end moment developed in the springings resulting merely in a slight transverse displacement of the pressure line.

The deck having been thus chosen as the major member for carrying wind loads, it became necessary to exclude all joints throughout its entire length from end abutment to end abutment. The expansion and contraction of the deck due to shrinkage, creep, and variations in temperature and humidity, take place therefore on a length of 1,000 ft, developing approximately symmetrically on both sides of the arch crown. The free movement of the deck over the arch pilasters is allowed for by providing two concrete rockers over each transverse wall of a pilaster. Each rocker consists of a 3-ft 6-in.-high continuous wall throughout the width of the bridge, provided with a continuous Freyssinet-type concrete hinge at top and bottom. The supporting columns in the approach trestles are fixed at the top in the deck and hinged at the bottom; however, they are flexible enough to follow the movements of the deck without being subjected to appreciable bending moments, with the exception of those next to the end abutments which, because of their short length, were hinged at both top and bottom.

Design of the Arch

1. Effect of live load on structure—calculations of influence lines

The moment of inertia of the deck being significant compared to that of the arch, deck and arch could not be designed separately. Calculation of the influence lines in the system was therefore accomplished as follows:

Step 1: Let

I = moment of inertia of arch
J = $I \cos \alpha$, projection of this moment on the horizontal line
I' = moment of inertia of deck

Assuming first that the columns supporting the deck over the arch are infinitely close to each other, it can be demonstrated that the arch-deck system is to be designed as a double-hinged arch having a moment of inertia projected at the horizontal line equal to $J + I'$. The moments M thus computed are to be divided between arch and deck in the direct proportion of their inertias and will therefore be:

$$\text{Moment of arch} = M \frac{J}{J + I'}$$

$$\text{Moment in deck} = M \frac{I'}{J + I'}$$

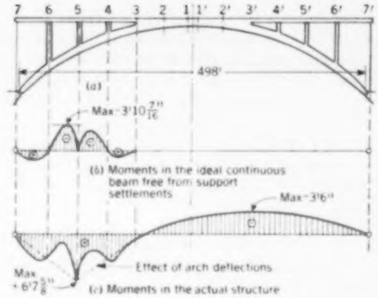


FIG. 5. Vertical deflections in spandrel columns change influence line of moments in deck, as illustrated in section over Column 5, in which actual moment is positive for adjacent span loading.

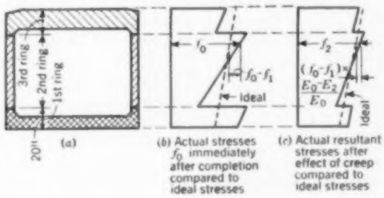


FIG. 6. Pouring rib in rings, or layers, changes distribution of stresses from ideal straight-line variation across rib section, as indicated.

Step 2: Columns carrying the deck are now considered at their actual location. This introduces additional moments in both deck and arch since the former acts now like a continuous beam, spanning the distances between spandrel columns, and the latter becomes loaded in a few concentrated points instead of being subjected to a continuous loading. These additional effects are added in the deck alone to the results of Step 1.

Step 3: The foregoing results are still approximate since the effect taken into account in Step 2 has changed the relative deformations of arch and deck. A more exact distribution of moments can be found by successive approximations. The reactions of the deck can be computed at the end of Step 2 and, considered as applied to the arch, will result in vertical deflections of the columns. These deflections are considered like settlements of the deck supports and their effect calculated as such. These corrections will be added to the results of Step 2.

Step 4: When the additional reactions in the columns resulting from Step 3 are applied again to the arch, additional deformations will be found which again can be considered like settlements of the deck supports. The results of all these computations show that the arch is slightly affected by the connection with the deck, but that the moments in the deck change entirely. As an example, the comparison of the influence lines for the moment in the deck over

Column 5 is shown in Fig. 5. If no settlement were to appear in Piers 4, 5 and 6, the influence line drafted in Fig. 5 (b) would show that the maximum negative moment is obtained by loading Spans 4–5 and 5–6. This same loading applied in the actual structure to the influence line shown in Fig. 5 (c) induces a positive moment in the same section, two to three times larger in magnitude.

2. Distribution of stresses in rib section

The arch rib is designed to be poured in three successive steps: (1) bottom chord and part of the web, to total depth of 20 in.; (2) the rest of the webs; and (3) the top chord.

A consequence of pouring in successive rings is that discontinuities will appear in the diagram of stresses f_0, Fig. 6 (*b*), as the first ring carries part of the load of the second, and the U-section composed of the first two rings carries the third. If all loads were to be applied at once after completion of the structure, the diagram of stresses f_1 would be as shown by the dotted line in Fig. 6 (*b*). However, the differences between the stresses f_0 and f_1 will be greatly reduced, thanks to the creep of concrete taking place after completion of the structure, which reduces the modulus of elasticity from an instantaneous value of E_0 to a final value of E_2. The expression of the final stress, after creep, can be demonstrated to be:

$$f_2 = f_0 + (f_1 - f_0)\frac{E_0 - E_2}{E_0}$$

The difference between f_1 and f_0 is therefore reduced after effect of creep by the ratio of moduli E_0 and E_2 normally equal to about 3. The diagram of final stresses f_2 is shown in Fig. 6 (*c*).

3. Secondary stresses induced by curvature in hollow arch rib

As mentioned above, the extrados consists of a series of straight lines between spandrel columns. No secondary stresses develop in the top chord, which is reinforced only to carry its own weight between the two webs of the section; on the contrary, the intrados is curved throughout its length. Compressive stresses f, acting lengthwise in the bottom chord of the rib, produce vertical upward reactions equal at each point to f/R (Fig. 7).

The maximum stresses at the bottom flange near the quarter-span point are 1,300 psi, and the radius of curvature $R = 300$ ft. The radial pressure is therefore

$$\frac{1{,}300}{300} \times 9.5 \times 12 = 495 \text{ psi}$$

This pressure is partially counteracted by the dead weight of the bottom chord, which amounts to 120 psf. This leaves a residual upward load of close to 400 psf, uniformly distributed transversely, which is balanced by downward reactions furnished by the webs. This results in transverse bending of the bottom chord, which under this load spans the 10-ft distance between the webs. Transverse mild-steel reinforcing is designed for this bending, and in addition, the arches are lightly reinforced in the longitudinal direction. However, the total amount of steel does not exceed 85 lb per cu yd of concrete.

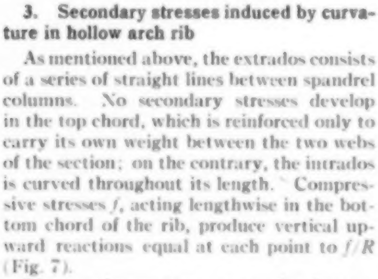


FIG. 7. Curvature of intrados of arch rib introduces secondary stresses in lower chord (bottom flange) of rib.

4. Buckling of arch

The transverse buckling of each individual arch rib does not present any problem since the unsupported length between foundation and deck is only 190 ft, and each rib is fixed at both ends.

Vertical buckling of the deck-arch system, on the other hand, calls for careful analysis. The deflection curve of the arch at the time of buckling has the shape shown in Fig. 8 (*b*), with opposite symbols of deflection at each side of the crown. Each half of the arch has the same buckling force as a straight beam having a span of $L/2$ and at each point a moment of inertia of $J + I'$. (As defined above, J is the projection of the inertia of the arch on the horizontal line, and I' the inertia of the deck.)

Numerical computations by the successive approximations method (assuming a modulus of elasticity, E, of 1,400,000 psi) show a safety factor of 5, which was considered satisfactory. This safety factor is slightly affected (about 3 percent) by the reduced moment of inertia of the arch at the crown.

A surprising fact is that the theoretical minimum buckling thrust of the arch calculated in that manner, will be the same as if it were computed for a three-hinged arch. Yet it is a universally recognized fact, proved by experience, as emphasized by Mr. Freyssinet in his article (which precedes), that a third hinge at the crown dangerously decreases the safety factor against buckling. The reason is that even if the theoretical minimum buckling loads are identical, the deformations to reach the buckling are very different in each case. For a three-hinged arch, the two halves can take separate deformations, and since the pressure line must pass through the same point at the crown, deformations of the second order, resulting from moments induced by an initial deformation due to an accidental cause or the effect of dead load, are of relatively great importance.

For the two-hinged arch, the pressure line can move appreciably up or down at the crown, providing an additional restraint of either half-arch. This is particularly true for the effect of dead load. Usually dead-load moments produce symmetrical deformations on both sides of the crown, and this results in a movement of the pressure line at the crown which avoids buckling with two waves of opposite sign, Fig. 8 (*b*). The next danger is buckling with three waves, Fig. 8 (*d*), occurring with an unsupported length $L/3$ thereby increasing the safety factor to a value of 11 instead of 5.

Thus the Caracas arches are seen to be extremely safe and stable against buckling, and yet they have great flexibility, a property of prime importance for minimizing the effects of thermohygrometric variations and possible movement of foundations.

Central-Arch Falsework

The center section of the arch falsework, acting as a trussed arch supported on each side by the cantilevered quarter-span falsework and the concrete poured on it, was obviously the member involving the most serious design problems. The sequence of pouring the bottom chord of the concrete arch was arranged to reduce as much as possible the bending moments resulting from unsymmetrical loads.

After completion of this first ring, the bottom chord acted with the falsework to carry the weights of the concrete sections subsequently poured. There a difficulty arises: What percentage of the load is taken by the concrete and what percentage by the wood falsework? The distribution of load depends on two unknown fac-

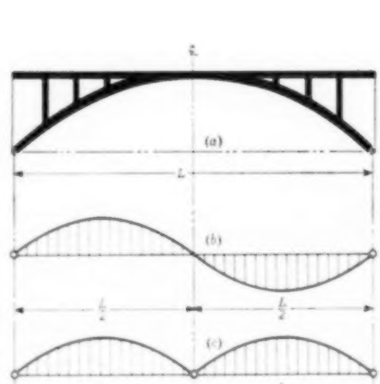


FIG. 8. Arch-deck system was investigated for buckling.

Photo, facing page:

Model of central arch falsework, built to scale of 1:5 and tested in Paris laboratory, verified calculations of deflections and stresses for falsework design. Model results, in turn, were verified by measurements on actual construction.

tors: the friction coefficient between falsework and concrete, and the ratio of the moduli of elasticity.

Investigation of the effect of the former showed that the falsework was very slightly affected, the stress in the bottom chord varying by only 10 percent whether the concrete was sliding without friction on the wood or whether on the contrary it was perfectly bonded. Adopting now a ratio of moduli between concrete and wood of $n=3$, the ratios between transformed areas and inertias of the two members were as follows:

	Areas	Inertia
First ring of concrete	20%	8%
Wooden falsework	80%	92%

The first section of concrete was therefore able to carry an important part of the thrust, but was too flexible to carry any appreciable bending moment.

The pressure curve induced in the concrete member by the load P of a particular section of the second ring has thus to follow the exact location of the intrados line. The result is that the concrete section is subjected to a continuous downward load W, having the same variation as the radius of curvature of the intrados at each point (Fig. 9).

The falsework is then subjected to an upward continuous load W of the same magnitude as the load applied to the concrete, and the concentrated load P. The important point was to investigate the influence of the ratio n (between concrete and wood moduli) on the value of W.

It was found that W had the following value:

$$W = W_0 \frac{n}{n + 0.75}$$

W_0 being a constant. When n varies from 3 to 6, which appear to be the extreme limits for the materials used, W varies only by 10 percent. All computations were therefore carried out using a value of 3 for n producing the maximum loading conditions for the falsework.

A 1:5 scale model 53 ft long, built and tested in the laboratory of Entreprises Campenon Bernard in Paris, checked the computations of stresses and the analysis of the deflections under the loads. The total deflection for full load was very low—only 3/8 in. in the 53-ft span of the model—giving an anticipated value of 2 in. for the actual structure. This value was confirmed with exactitude by the survey made during construction.

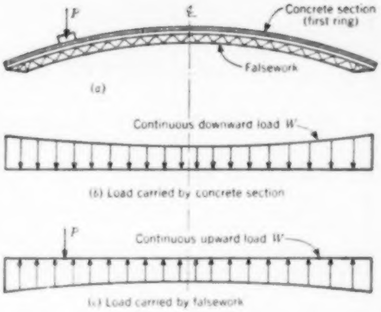
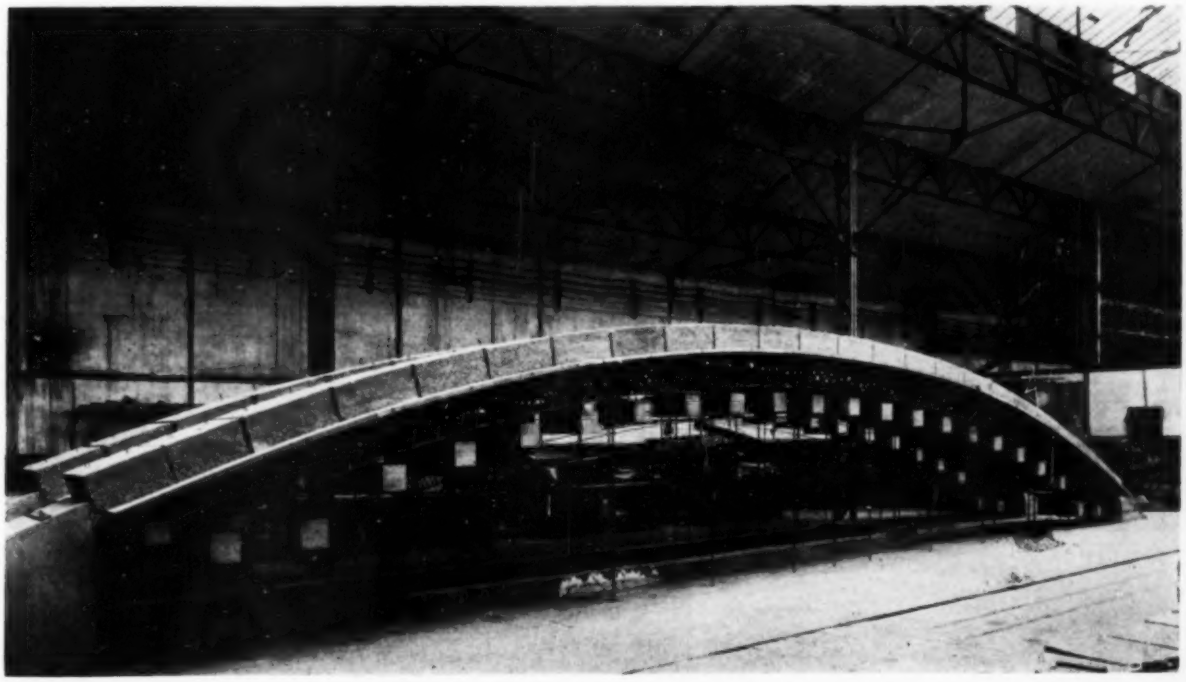


FIG. 9. Load on central falsework, with first ring of concrete poured, is assumed to be divided between concrete and falsework in ratio of moduli of elasticity of the two materials.

A satisfying indication of the adequacy of the analysis of the arch falsework is the successful completion of the first of the three bridges in January 1953, and the raising, according to schedule, on February 12, 1953, of the central section of the falsework of bridge No. 3, using again the same falsework elements as for bridge No. 1.



Largest concrete spans of the Americas

How they were built

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Before giving some details about the construction of the first of the three bridges on the Caracas–La Guaira superhighway, a brief description of the site installations and plant layout will be of interest. This bridge No. 1 is the largest of the three and the first completed.

At the Caracas end of this bridge, a 2-acre graded yard was provided for the precasting and storage of 7,500 tons of beams, slabs, arch hinges, cross-beam elements, and railing, as well as for general stores, workshops, dressing rooms, power plant, cement storage, sawmill and timber storage, office, carpenter's tracing platform, cableway tower and operator's cabin, cable and sheath-making area, and a concrete batching plant. The deck beams for the half of the bridge toward Caracas were precast in this yard, but space had to be found at the La Guaira end of the bridge for precasting and storing the 84 deck beams required for the half of the bridge toward La Guaira, since the cableway did not have the necessary capacity to transport them across the canyon. Construction roads for trucks hauling concrete materials and other equipment, and for the movement of the smaller precast elements and falsework units had to be provided.

Unusual for this part of the world was the complete electrification of the job. All cranes, mixers, vibrators, cableways and winches were driven by motors drawing energy from the 150-kw a-c power plant built at the site, which supplied current at 220 v. A 5-ton, 1,275-ft-span aerial luffing cableway, also electrically operated, handled all concrete, forms, steel and falsework units. Both the head-tower and tail-tower masts could be swung 28 ft from the vertical on each side to command the whole length and width of the bridge.

Foundations Specially Constructed

For the abutments at the ends of the bridge, the foundations rest on hand-dug, concrete-filled wells 30 ft deep. On the La Guaira side, the approach piers also rest on such wells, three for each pier. On the Caracas side, the steep and soft nature of the ground required special foundations for the approach piers, as can be seen in Fig. 1 of Mr. Muller's article which precedes. The vertical load supported by this foundation is resolved into two components, one of which is transferred to the main arch abutment by three inclined buttresses, and the other is transmitted to the ground at right angles to its slope and to its natural cleavage planes.

Because of widely varying geological conditions at each side of the gorge the foundations under the pilasters differ greatly. On the La Guaira side, the ground is a hard clay changing gradually to cemented gravel at depths of 30 to 50 ft. On this side the pilaster and the arch are founded on a raft in the shape of a hollow prestressed concrete box which distributes the 16,000-ton total load at 3.5 tons per sq ft. This

Yard for casting and stockpiling precast, prestressed beams was located at each end of bridge No. 1.

Reinforced concrete vibrating table supports 12-ton steel form 50 ft long for precasting deck beams. In addition, electric vibrators are attached to form.

fairly intricate foundation, as high as a six-story building and containing 2,840 cu yd of concrete, was built in a 9,000-cu yd excavation made with a $^1/_2$-cu yd Lorain shovel.

For the pilaster at the Caracas end of the arch, the nature of the ground required a foundation consisting of a system of seven vertical concrete-filled wells and three inclined concrete buttresses, on top of which a light structure was built to receive and distribute the arch thrust and the weight of the pilaster to the wells and buttresses. The seven wells of 6-ft 4-in. diameter, were dug by hand to a depth of 60 ft, to penetrate 10 to 15 ft into sound rock. To prevent caving during excavation, a ring of concrete 8 in. thick was placed around the well at the end of each digging shift. At the bottom, these wells were enlarged to 11-ft diameter in the shape of an elephant's foot.

The three inclined buttresses, one behind each arch rib, were concreted in three galleries $7^1/_2$ ft square excavated to a depth of 96 ft and penetrating 10 ft into sound rock. Because of the bad ground, the galleries were timbered and shored for most of their depth. However, all timbers were removed before concreting so that the concrete would be in contact with the ground on the four sides of each buttress to develop maximum side friction and direct bearing capacity.

The construction procedure for the superstructure of bridge No. 1 will now be described in detail, it being understood that the same procedure is being followed in all main steps on the other two bridges. Bridge No. 1 was completed in January 1953; Nos. 2 and 3 are under construction and expected to be completed this year.

Floor System Precast

While the foundations were being constructed, precasting operations were started at the two sites, one at each end of the bridge. The principal point of interest about this work was the use of vibrating tables under the forms for the beams and hinges. These tables, four at each site, were made of reinforced concrete and were capable of vibrating elements as long as 50 ft and weighing, with the steel forms and their attached vibrators, up to 35 tons. New tables had to be cast at each bridge site as they could not be transported from place to place. When trained, a crew of 9 to 10 workmen, using two steel forms, could cast four beams weekly. The steel forms and molds were made fairly heavy, since each had to be reused over a hundred times without appreciable deformation. Concrete for the precast, prestressed beams was quite dry, containing about 4.40 U. S. gal of water per sack of cement.

Approach Piers Hinged at Base

With the foundations for the approach piers completed, the cableway picked up the hinges for the foot of these piers from the casting yard as soon as they were ready. These prestressed Freyssinet hinges, one of which is shown in a photograph, were then grouted to their respective foundations and the pouring of the piers was started, using special steel forms attached to the hinge blocks. Pouring progressed continuously at the rate of 5 ft per day, using two sets of forms moved upward by the leap-frog method.

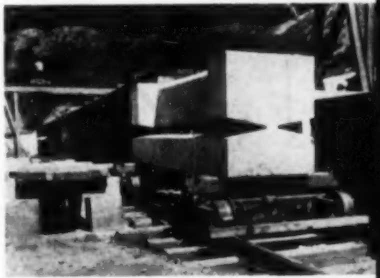
Because of the hinge at its base, each pier had to be supported until the deck beams were in place. Up to a height of 25 ft, this support was provided by light tubular steel scaffolding erected around each of the three columns of the pier and then connected together. At every succeeding 25-ft increment in height each column was braced to the previous one by a light timber truss.

Reinforcing steel was placed as the columns rose, and at the same time vertical holes for the prestressing cables were cast in the concrete by inserting $1^1/_2$-in.-dia steel tubes and withdrawing them $1^1/_2$ hours after concrete was placed.

As soon as the three columns of an approach pier were completed, precast cross-beam elements were placed on top of them and they were prestressed vertically by threading cables through holes in the cross-beam elements, as shown in Fig. 3 of Mr. Muller's article. Then the columns were connected together by placing two intermediate precast cross-beam elements to complete the top member of the bent.

These elements were placed by cableway and temporarily supported in position by steel brackets until they were fixed in position in the following manner. First, four 18-wire prestressing cables were threaded through the longitudinal holes left in the cross-beam elements when they were precast. Then the four vertical $1^1/_2$-in. joints between the ele-

Seven hand-dug wells 60 ft deep, when filled with concrete, were used to support arch and pilaster on Caracas side of bridge No. 1. View looking down one of these wells shows concrete lining, placed in successive rings to prevent caving.

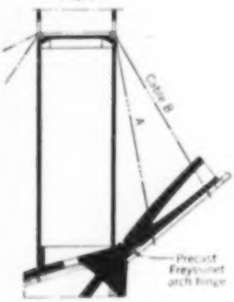


Freyssinet foot hinge, of precast, prestressed concrete, is used at base of all approach piers.

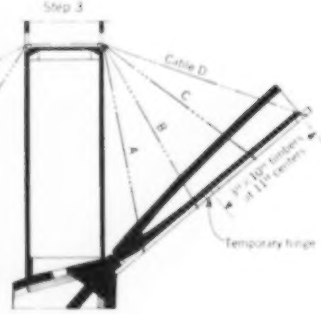
Approach piers, on foot hinges, must be braced to stabilize them until deck beams have been placed by gantry.

Step 1

Step 2



Step 3



ments and those placed previously on top of the columns were packed with a rich mortar. After 8 to 10 hours, these four horizontal cables were prestressed and anchored to complete the top member of the pier bent, which was then ready to receive the deck beams and slabs.

The two arch pilasters, one at each end of the arch proper, are thin hollow shells, 137 ft high, 20 × 80 ft in plan, with three interior cross walls. These pilasters were concreted in place like an ordinary concert silo, using special steel forms moved by the leap-frog method. Walls and inside partitions are 4 ³/₄ in. thick. The vertical prestressing required for stability against wind was supplied by ten 18-wire cables anchored into the foundation of each pilaster.

Deck Beams Placed by Gantry

Placing of the precast deck beams and floor slabs began as soon as the bridge abutments and first approach piers had been completed. The gantry used for this purpose is a 126-ft structural-steel lattice girder, of which 60 ft extends as a cantilever. This gantry is capable of supporting a 25-ton load at 28 ft. Three electrically operated trolleys run on the top members of the gantry to handle loads suspended between the members. Two of the trolleys have a capacity of 15 tons for handling, between them, the 23-ton beams. The third trolley, of 2-ton capacity, handles slabs. Two sets of wheels under the gantry allow movement in two directions at right angles to each other.

For placing beams and slabs in the deck, the sequence of operations is as follows:

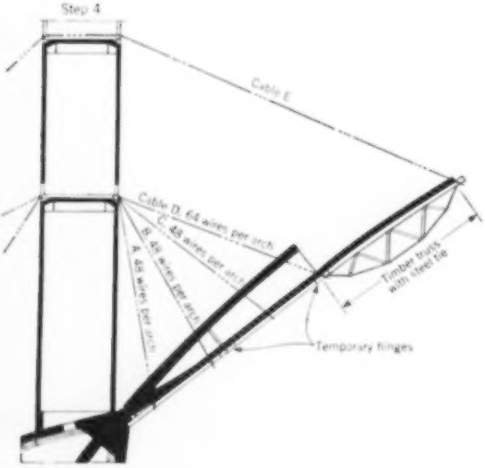
1. Move gantry to position on completed deck section preceding section to be placed.
2. To gantry attach transverse wheels which run on heavy steel rails.
3. Bring deck beam to gantry on meter-gage track and pick up forward end of beam with 15-ton trolley.
4. Move trolley forward and pick up rear end of beam with second 15-ton trolley.
5. Move gantry transversely to exact alignment with final position of beam in structure.
6. Move both trolleys forward onto cantilevered portion of gantry, until beam is exactly over its final location; then lower it onto its supports.
7. Return trolleys to rear of gantry and move gantry transversely back over supply track in position for picking up next beam.
8. With all beams in position between the two piers, place gantry in line between two beams and place floor slabs on temporary steel brackets fixed to top flange of beams.
9. With all deck beams and slabs in place in the 48-ft span between two piers, pass transverse prestressing cables through top flanges of beams, pack 1¹/₂-in. longitudinal joints between slabs and beams with cement mortar, and after 8 to 10 hours, complete the span by stressing, anchoring, and grouting the prestressing cables.

A crew of 16 men, in 9 working days, carried out all the operations necessary for launching the 8 beams and 112 slabs required to complete one 48-ft span.

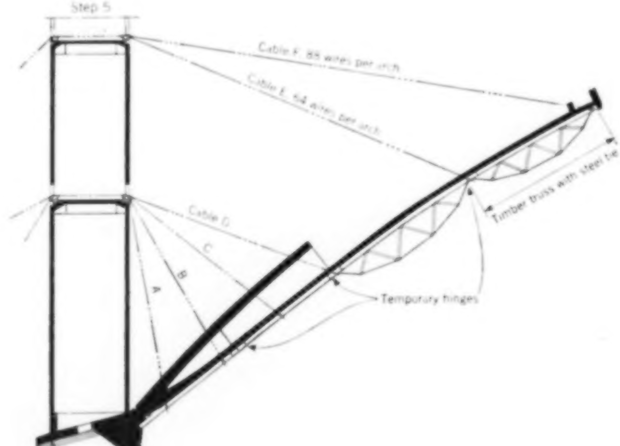
The decks on the two approach viaducts, when in place, were prestressed longitudinally by cables laid in grooves in the top flanges of the deck beams, anchored at one end over the arch pilaster and at the other in the end abutments of the bridge.

The Freyssinet prestressing cables and their sheaths were assembled on the job. Cables of two capacities were required—12-wire and 18-wire cables, capable respectively of an effort of 20 and 30 tons after all relaxations, shrinkages, and creep had taken place. The cables, protected by

Step 4



Step 5



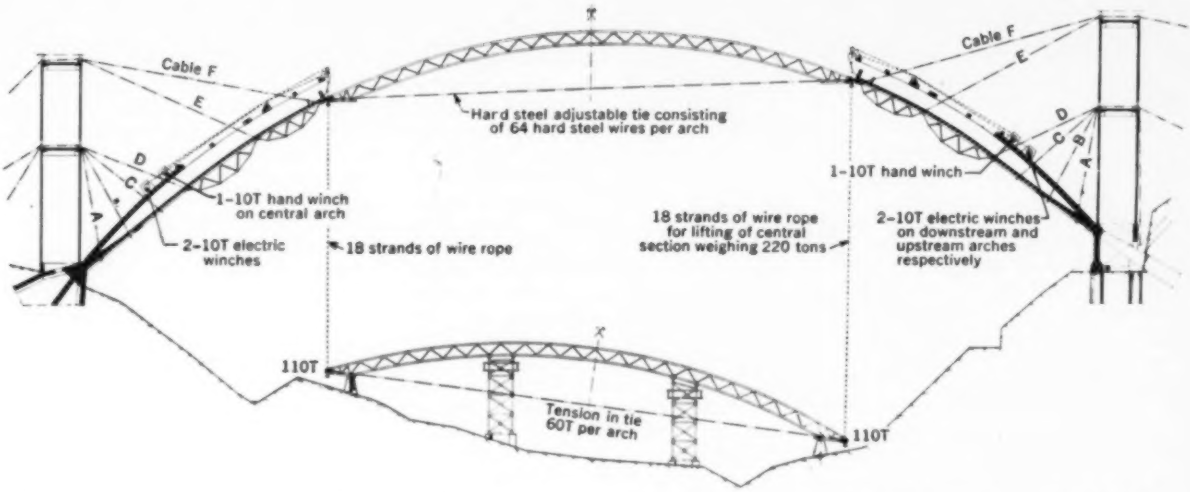


FIG. 1 Concrete ribs poured on cantilevered timber forms, in successive increments shown in heavy black, added enough strength to support central section of timber form work. This section, which is 74 ft wide, weighs 220 tons and spans 267 ft, is shown completely assembled on ground and in final position. Total falsework span is 498 ft.

their sheaths, were placed in the forms before the beams were precast.

Light Wooden Cantilever Falsework

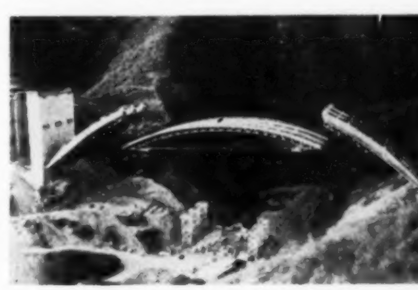
As every engineer familiar with bridge work knows, there is no part of the construction of a concrete arch bridge that is more important than the falsework. On its design and construction largely depends the success of the job. The necessary characteristics of a good falsework are that the combined cost of labor and materials will be a minimum, that the falsework will be strong and stiff enough to hold its shape and alignment during concreting, that it will strip easily and without shock to the concrete, and that it will have a high salvage value.

The specific requirement for the first Caracas arch span was a falsework of 498-ft span, 230 ft above ground, and 70 ft wide to support three ribs during construction. As Mr. Freyssinet stated in the preceding article, he decided on a light wooden falsework (as shown in Fig. 1 of this article), which could be reused almost in its entirety for the two other bridges.

At the springing line of the arch on each side, cantilevered forms for one-quarter of the span were erected piece by piece, suspended by cables anchored in the foundations of several approach piers and passing over the pilaster on the side in question. The form for the central half of the span consisted of a trussed falsework supported by the ends of the quarter spans on each side.

Falsework for the cantilevered quarter-spans consisted of four small trussed units for each rib erected independently of each other and braced to-

Falsework for arch ribs consists of two quarter-span forms, cantilevered from springing line, supporting central trussed half-span. In view above, central falsework span is ready to be hoisted into place; below, it approaches final position.



Concreted arch ribs stand alone while falsework for center section is lowered.

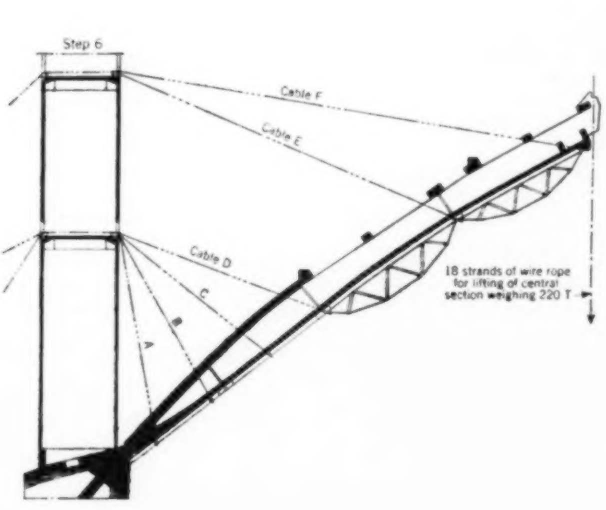


FIG. 2. Erection of falsework and concreting of arch ribs was accomplished in seven steps. Concrete placed during each step is shown in heavy black. In Step 6, sides and cross pieces on top have been poured, but not main part of top. Raising of center section of falsework and completion of arch rib on it was Step 7 (see Fig. 1).

gether from rib to rib to improve their stability against transverse winds. This falsework, with four hinges in each rib on each side, one at the junction of each truss unit, was very light and flexible. It was given the required stiffness by concreting the whole ring of the arch rib over each section of falsework before the next section was lifted into position.

The falsework for the central half of the bridge, on the other hand, was assembled on the ground under the bridge in one piece, in the form of a timber truss 267 ft long, 70 ft wide and weighing 220 tons. It was then lifted into position and fastened at each end to the ends of the cantilevered quarter spans already in place.

Including plywood, the total timber requirements for the arch falsework were 175,000 fbm, or an average thickness of $6^1/_4$ in. over the whole span. A conventional trussed falsework crossing the canyon in one 498-ft span would have required at least four or five times as much timber.

Erection and Concreting Sequence

The first unit in the quarter span falsework for each rib was a timber platform 31 ft long, which was 27 ft 8 in. wide at the springing line of the arch and 17 ft 2 in. wide at the other end. This platform consisted of 3 × 10-in. timbers on edge at $10^1/_2$-in. centers, assembled firmly and covered on the upper face with $^1/_2$-in. plywood. This platform provided the form for the bottom of the box-shaped arch rib.

For the first section of the cantilevered quarter span, three of these units, each weighing 5 tons, were placed, one at a time, by the cableway suspended by the anchor cables, and adjusted to exact position by hydraulic jacks at the foot of the anchor cables, as shown in Figs. 1 and 2. Next, four 4-ton precast hinge-block sections were swung into place at the springing line of each rib and assembled into one hinge block by prestressing cables. Forms for the ribs were erected on the falsework, and concreting began. As the weight of each increment of concrete placed came on the anchor cables, they stretched and had to be carefully pulled up into position by the adjusting jacks.

After the arch rib section of Step 2 had been concreted, falsework section No. 2 was attached to it and supported by two more anchor cables. After adjustment to the intrados curve, concreting continued. Because of the position of the suspension cables and the concreting sequence, angular deformations were possible between falsework sections Nos. 1 and 2. For this reason a temporary concrete hinge was placed in the lower member of the arch rib which would allow angular deformation but would transmit the normal effort required to insure the equilibrium of the system. Once the sections of rib on the first and second falsework sections were concreted and the anchor cables adjusted, the temporary hinge was blocked and the two sections of concrete were tied together by prestressing cables. (In the same way a temporary hinge was used between each of the four sections of concrete on the cantilevered quarter span on each rib and at each end of the central half-arch section.)

This first piece of arch rib thus became a continuous beam supported at the outer end by cables, and during construction of the rest of the arch its level was adjusted by cable "D". Step 3 is now complete.

Next, in Step 4, the first unit of trussed falsework, weighing 11 tons, was erected. It was too heavy for the cableway to lift in one piece so it was assembled on the bottom of the canyon under its future location in the arch. The outer end was lifted by the cableway and the inner end by a winch fixed on the end of the previously concreted section of the arch. Suspension cables, passing over the top of the arch pilaster, were attached and adjusted, and the bottom concrete of the new rib section was placed. The next trussed section of falsework could then be added.

In Step 5, the bottom concrete of the rib was placed on the last trussed section of falsework, including the small concrete brackets which protruded below the bottom member to take the thrust of the 267-ft central falsework after it was lifted into place.

In Step 6, the last phase of the quarter-span concreting, the side walls of the ribs were concreted, as well as a few narrow strips across the top, to give more stiffness to the rib members, which had a U-shaped cross-section at this stage.

The anchor cables were again adjusted to bring the two cantilevered quarter spans, each 125 ft long, exactly to final position.

Everything was now ready for the raising of the central section of the falsework, which was resting on the ground directly under its future position in the arch.

This central 267-ft falsework span had been constructed on the carpenter's tracing platform in elements 85 ft long, 13 for each rib. These elements had then been transported by cableway to the bottom of the canyon, where they had been assembled on a light staging directly under their intended position in the arch. The ends of the timber falsework arches were tied together by steel cables acting as ties, to keep the arches rigid.

Eighteen $^7/_8$-in. wire cables were sheaved between the ends of the protruding quarter-spans and the ends of the central section of the falsework. These cables were connected to four 10-ton electric winches placed on the already concreted outer ribs of the arch, and to two 10-ton hand winches on the center rib. The whole 220-ton falsework was then hoisted into position during an operation which required 8 hours.

Once this central section of falsework was in place, and the level of the crown was regulated exactly, cement mortar was packed in the gap between the ends of the central section of falsework and the quarter-span falsework, and extra-flat sand boxes were embedded in the joint for subsequent striking of the central falsework.

Two days later, the steel tie cables on the central falsework were released and the winches which had been supporting the section were loosened. From this operation on, the central section acted as a trussed falsework, and the combination of concrete so far placed, with the falsework, acted as a complete arch from abutment to abutment.

Next the bottom portion of the rib boxes was concreted up to the crown on each side in a previously arranged sequence, as explained in Mr. Muller's article, and temporary crown hinge blocks were placed. The other temporary hinges between the elements of the quarter spans were then blocked and suspension cables "A" and "B" completely released. The combination of timber falsework and partly built concrete arch ribs continued to be held in place by cables "D," "E," and "F," with a temporary hinge at "F" only.

The side walls of the rib boxes over the central section were next concreted up to the crown key; suspension cable "D" was released; crown concrete was completed; the remaining construction joints were tied with prestressing cables; and the last anchor cables—"E" and "F"—were released. Now the concrete arch, although incomplete (the top of the ribs on the central 260-ft section was still missing), was carrying itself, as well as the dead load of the entire falsework.

Then came the operation of removing the falsework. The cement joints at the ends of the central falsework were destroyed; the sand boxes were emptied; and after the steel cable tie was retightened, the central section of falsework was lowered to the ground. During succeeding days, the cantilevered falsework elements for the quarter-spans were lowered by hand winches.

The spandrel columns were concreted next, and then, following a carefully worked-out sequence, the top of the arch rib boxes over the central part of the span was concreted. As soon as this was done, the deck beams and slabs were placed in the manner previously explained, taking care to place the beams symmetrically, and simultaneously on both sides of the crown.

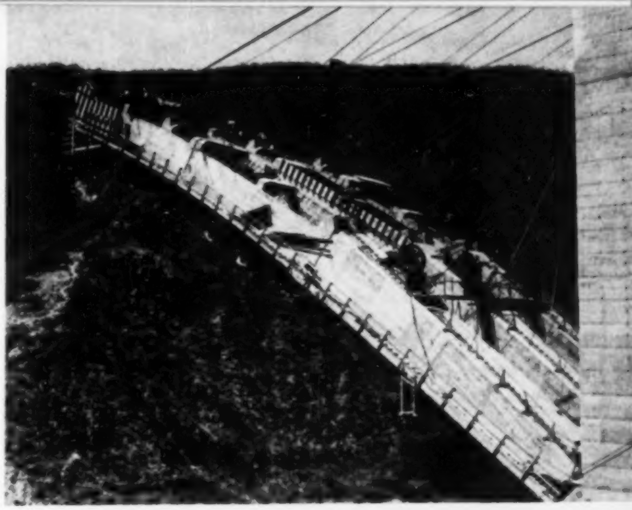
After the deck over the arch had been placed and prestressed transversely, it was prestressed longitudinally in the same way as the approach viaducts. With this operation the whole length of the bridge deck, from abutment to abutment, was tied together longitudinally with prestressing cables. The level of the crown was maintained by adjusting the flat jacks and concrete wedges which had been placed at the crown.

During the various phases of construction of the ribs, particularly when the arch was completed and the anchor cables removed, the crown carried nearly its full weight, whereas the quarter points were not yet loaded. This caused bending moments at the quarter points large enough to produce dangerous tension in the unreinforced rib concrete. To offset this effect, temporary prestressing cables were placed to run along the extrados of the arch rib at the required places. These cables were removed progressively as the spandrel piers, deck beams, and floor slabs were placed.

By the extensive use of temporary prestressing, applied as and where required, it was always possible to control bending moments and tensions during the various construction steps. Without this control by prestressing cables, it would not have been possible to build this 498-ft arch on such light falsework.

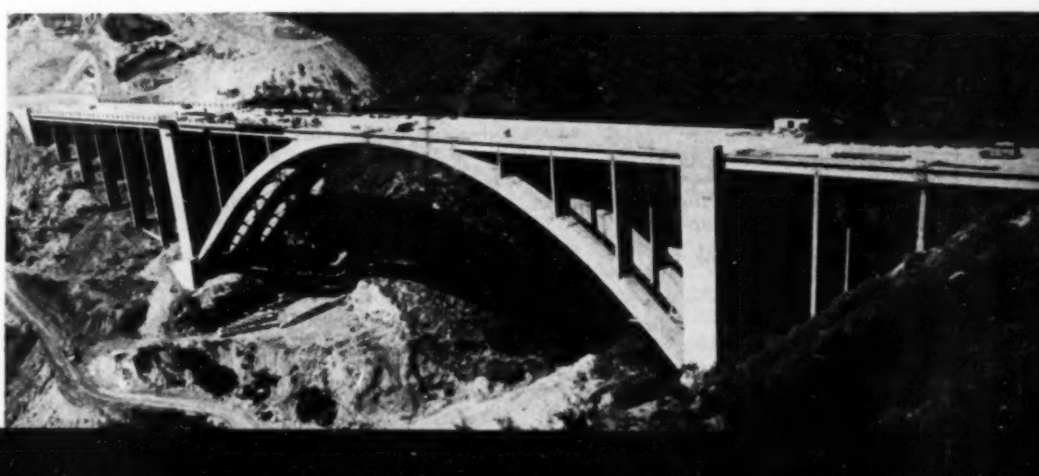
With their total deck area of 176,500 sq ft and total length of 2,543 ft, the three bridges on the Autopista will cost about $5^1/_2$ million dollars. Their structural design was by Mr. Muller under the supervision of Mr. Freyssinet, and their falsework by Pierre Decharne of the contractor's Paris office.

(This article is based on the paper presented by Mr. Shama before the session on Prestressed Concrete of the ASCE Structural Division and the American Concrete Institute, presided over by A. E. Cummings, chairman of the ASCE Research Committee, at the Centennial of Engineering in Chicago.)



Last phase of work on quarter-span of bridge No. 1, before raising of center-span falsework, ends with concreting of sidewalls of box ribs and some narrow strips of top member to give stiffness to temporarily U-shaped ribs. Winches for lifting center-span falsework are in position. This photo illustrates Step 6 of Fig. 2.

La Guaira end of arch is supported by hollow concrete box (see Fig. 1 of Mr. Muller's article), to distribute 16,000-ton load at 3.5 tons per sq ft. Bottom slab of raft, here seen under construction, is 2 ft 8 in. thick, reinforced by 18-wire prestressing cables. Loads are transmitted to this slab through seven longitudinal partitions, one transverse diaphragm, and walls and roof of box. This foundation structure, as high as a six-story building, contains 2,850 cu yd of concrete and 32 tons of steel.



Bridge No. 1 was completed, except for handrails, on December 30, 1952.

Record-size pump-turbine at TVA's Hiwassee project

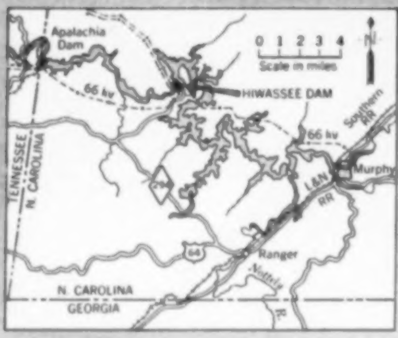


FIG. 1. Hiwassee Dam, one of major multiple-purpose dams of TVA system, discharges into Apalachia Reservoir. Upper 8 ft of this reservoir, containing 8,700 acre-ft, will serve as suction pool for Hiwassee's new pump-turbine unit.

TVA will take advantage of the recent development of a single hydraulic machine capable of operating at high efficiency both as a pump and as a turbine. A 70,000-kva reversible unit using a runner of this type will be installed at the Hiwassee hydro development on the Hiwassee River in North Carolina. The Allis-Chalmers Manufacturing Co. has been awarded a contract to build the pump-turbine and the motor-generator. Woodward Governor Co. will supply the actuating equipment. The contract price of the pump-turbine is about $1,217,000; of the motor-generator, $1,280,000; and of the actuator, $55,000.

The reversible pump-turbine will utilize the largest Francis-type runner ever built. As a turbine it will have a maximum output, limited by generator capability, of about 102,000 hp at a head of 208 ft. When motor driven, the unit will have a pumping capacity of 3.3 billion gal. The pump has more than three times the capacity of each of those serving the Grand Coulee irrigation project, the world's largest now in operation. The electrical motor generator is equally imposing. As a motor it will be the world's largest, rated at 102,000 hp at 105.9 rpm. It is approximately 50 percent larger than the motors driving the Grand Coulee pumps. As a generator it is rated at 70,000 kva, 13,800 v.

One conventional, Francis-type unit was installed at the Hiwassee project during initial construction some 13 to 16 years ago and was put on the line in May 1940. Powerhouse space was provided for the future installation of a second unit of the same type and size. However, this plan was changed because of the comparatively recent development of a reversible unit, which rotates in one direction as a turbine and in the opposite direction as a pump, offering decided advantages over a conventional unit. On the average, the pump-turbine will increase the annual energy output of the plant by 26,000,000 kwhr more than could be obtained from a duplicate of the existing unit. A substantial part of this additional generation would be on-peak energy produced during the high-load season of the year. Because of its favorable effect on reservoir levels and operating heads, the new unit also will make available more dependable capacity to meet peak loads. This latter characteristic makes the pump-turbine installation particularly attractive in the TVA system of hydro- and steam-generating plants.

A pumping unit was among the various installations investigated during the early planning for the Hiwassee project. At the time, it failed to prove economically attractive largely because of the excessive cost of installing a separate turbine and pump and the relatively low pumping efficiency expected. However, the recent development by turbine manufacturers in this country of the reversible unit, or pump-turbine, led to further investigations and finally to the decision to install such a unit at Hiwassee.

The Hiwassee project (Fig.1), located in the mountains of western North Carolina near the Tennessee boundary, is one of the major multiple-purpose developments of the TVA water-control system. Construction of the Hiwassee Dam was authorized by the U.S. Congress on August 12, 1935, and preliminary construction was started in July 1936. Major construction got under way in October 1937, when the first cofferdam was completed and unwatered. The dam was closed February 8, 1940. It is a concrete gravity-type structure having a maximum height of about 300 ft, measured from the point of deepest excavation.

The powerhouse, of the semi-outdoor type, is on the left bank of the river at the toe of the dam. One 57,600-kw generating unit is in use, and space is available for a second unit of equal size. The prime mover is rated 80,000 hp at 190-ft head, 120 rpm, and was built by the Newport News Shipbuilding and Drydock Co. The Westinghouse generator is rated at 64,000 kva, 57,600 kw, 60 deg C rise, 0.9 power factor, and 13.8 kv.

During the initial construction, the trashrack structure and penstock for the second unit were completed, and a hemispherical bulkhead seal was inserted near the upstream end of the penstock liner. The intake gate was not installed, but excavation for the draft tube and tailrace was completed and a concrete sill was built downstream from the area to be occupied by the draft tube. On this sill, a rock-filled, timber-crib cofferdam was built up to El. 1,264.

Hiwassee is tied in with the TVA transmission system by two 154-kv lines, one to a switching station serving the Aluminum Co. of America plant at Alcoa, Tenn., and another to the switching center at the Apalachia powerhouse. There is also a 66-kv line from Hiwassee to Apalachia Dam and powerhouse and another to the substation in Murphy, N.C.

Total cost of the Hiwassee project was $16,844,000. Of this amount, approximately $15,923,000 was for land, railroad and highway relocations, reservoir adjustments, dam, and powerhouse. The switchyard cost approximately $921,000.

Immediately downstream from the Hiwassee powerhouse is the reservoir of the Apalachia project, which controls tailwater levels and forms the afterbay for discharges from Hiwassee.

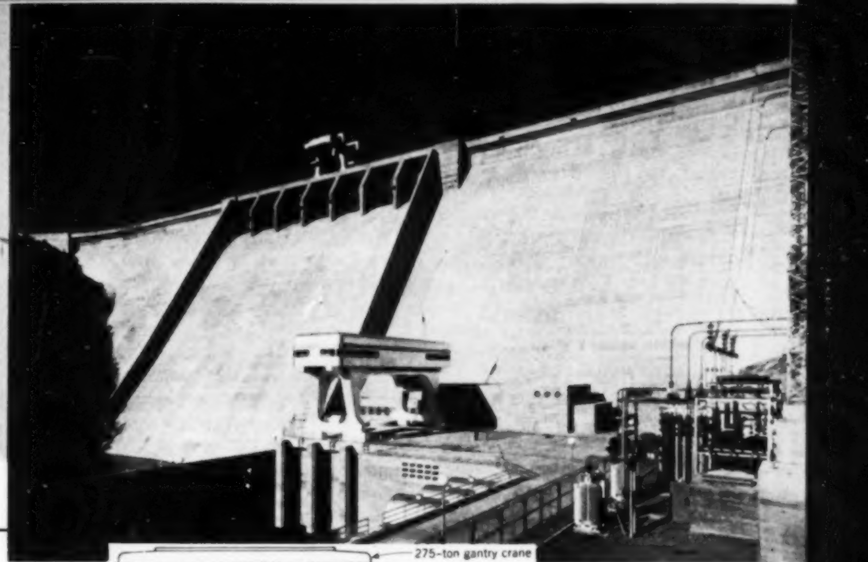
The centrifugal pump and the Francis-type turbine are enough alike physically so that either could be made to perform the function of the other, although at greatly reduced efficiency. Development of a dual-purpose runner has been under way for some years by the manufacturers of hydraulic equipment, but only recently has it been found possible to

to be installed

REED A. ELLIOT and

DON H. MATTERN, Members ASCE

**Chief and Assistant Chief, respectively
Project Planning Branch, TVA, Knoxville, Tenn.**



Hiwassee project built in western North Carolina in 1940, is now to have its power capacity expanded. Development of new high-efficiency pump-turbine units led TVA engineers to investigate economic feasibility of pumped storage. Studies led to purchase of 70,000-kva reversible unit to form second unit of structure, to be installed to left of unit No. 1, located directly under gantry crane.

combine high pump and turbine efficiencies in a single machine.

The runner, or impeller, of the reversible pump-turbine unit designed for installation at Hiwassee will be 266 in. in diameter at the center line of the distributor, as compared with the 165.2-in. diameter of the conventional unit No. 1. Because of the greater size of the runner, the scroll-case dimensions will also be larger. Measured through the center of the unit, out-to-out dimensions of the pump-turbine scroll case will be approximately 54 ft normal to the penstock and 49 ft parallel to the penstock. The comparable dimensions of the scroll case of the existing unit are about 49 and 41 ft.

The setting for a pump-turbine unit is determined by the relation between the pump impeller and the lowest level to which the suction pool can be drawn during the pumping cycle without causing serious cavitation. In this instance the suction pool will be the reservoir created by Apalachia Dam. The center line of the distributor for the Hiwassee pump-turbine will be set 1 ft below the minimum elevation to which the Apalachia Reservoir might be drawn. This level, El. 1,271, is 6 ft lower than the setting of the turbine for the existing unit. However, since the vertical leg of the pump-turbine draft tube can be 4.5 ft shorter than the draft tube for the conventional turbine of unit No. 1, the elevation of the bottom of the draft tube will be only 1.5 ft lower, or at El. 1,238.5. This slightly greater depth of draft tube will require some additional rock excavation within the powerhouse area (Fig. 2).

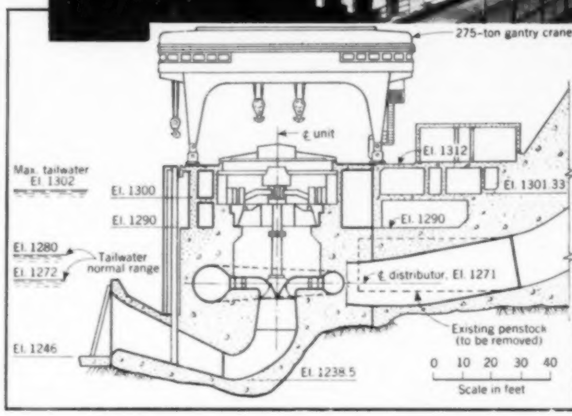


FIG. 2. Center line of distributor of pump-turbine unit is set 1 ft below maximum elevation to which Apalachia Reservoir might be drawn. This is 6 ft lower than center line of existing distributor.

The reversible unit will operate at 105.9 rpm both as a turbine and as a pump. Its runaway speed is estimated as 165 rpm as compared with 235 rpm for a conventional unit. A lower overspeed potential is characteristic of a pump-turbine unit and can be taken into account when designing the motor-generator.

Nominal rating while operating as a turbine is 80,000 hp at 190-ft head. Guaranteed output at this head is 83,000 hp, with an efficiency of 87.3 per cent. When operating as a pump, the reversible unit will be rated at 3,900 cfs against a head of 205 ft. At this head, the pump will require a motor output of 102,000 hp. When operating as a motor, the motor-generator will be rated at 102,000 hp, 80 deg C rise, 0.95 power factor leading, and 13.5 kv.

Because the maximum pumping load will occur only during that portion of the year when temperatures of water used for cooling purposes are low, the overload capability built into the motor-generator can be utilized dependably. Expected motor efficiency at this rating is above 97 percent. As a generator, it will be rated at 70,000 kva, 59,500 kw, 60 deg C rise, 0.85 power factor lagging, and 13.8 kv. Expected generator efficiency at this rating is better than 97 percent. The motor-generator will be of the umbrella type, having a combined thrust and guide bearing which is located under the rotor.

When the unit is to be used for pumping, the starting sequence will be as follows. With the wicket gates closed, air under pressure will be admitted above the runner to depress the water to a level below the rotating parts. This done, the motor will be started and brought up to speed with the runner rotating in air. Air pressure will gradually be reduced and water allowed to refill the draft tube. With the unit rotating at normal speed, the wicket gates then will be opened gradually, thus completing the starting sequence.

Before starting, a high-pressure lubricating system will establish a positive oil film between the stationary and rotating parts of the thrust bearing in such a way that the unit will "float." The required starting torque is expected to be less than 5 percent of the full-load running torque.

Major tributary projects in the TVA system (which include Hiwassee) provide a substantial degree of regulation of runoff from the tributary

watersheds. The typical operation of these projects to achieve flood regulation and power production is illustrated by the Hiwassee project in Fig. 3. This type of operation usually results in ample releases for power generation during the summer and fall months as the reservoirs are drawn to lower levels. However, the enforced drawdown and the scheduled reservoir filling during the winter months to maintain flood storage capacity place a limitation on the availability of generating capacity. Thus, these plants will usually operate at a low plant capacity factor through the winter season.

The heaviest power demands on the TVA system occur during the winter months. Ordinarily loads build up during November and December to an annual peak during January. Because of the substantial use of electricity for heating, the date of the peak is influenced by the weather. Discounting overall load growth, demands usually are somewhat lower in February and March, with a more pronounced drop after early April.

For economy of system operation, the available hydro-generating capacity must necessarily be utilized to the fullest extent feasible during this season of high load. Tributary plants, such as Hiwassee, can contribute effectively to system peak loads by operating some 50 to 60 hours a week from the middle of December to the middle of March, and somewhat fewer hours in the few weeks preceding and following this period. The greatest value of the second generating unit at Hiwassee would be in its contributions during this time of year.

In the earlier stages of development of the TVA system, the essential power function of tributary storage projects was to maintain a dependable level of power through seasons of low flow by release of stored water. Although this function is still characteristic of such projects, the higher system-load levels and the existence of proportionately more steam generating capacity results in a greater need for hydro capacity fully available to meet peak loads. It is desirable, therefore, to limit the reservoir drawdown to the amount essential for flood control and thus avoid extreme reduction of head and correspondingly of turbine output.

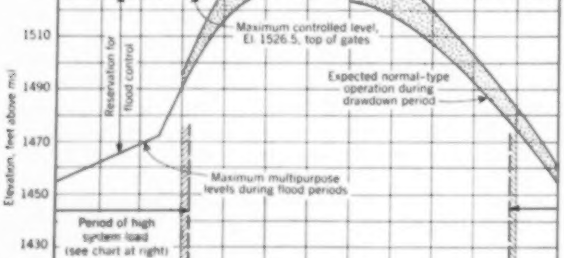
In most years the stream flow is sufficient for adequate use of the generating capacity of the present one-unit plant while at the same time allowing the Hiwassee Reservoir to fill to normal seasonal levels. If a second conventional generating unit were installed, the greater releases required for peak operation of the plant during the winter months would usually result in reservoir levels below those required by the flood control schedule. This would result in a lower operating head and a limitation on the power output. By installing a pump-turbine for the second unit, the off-peak pumping will return to the reservoir a part of the on-peak releases of the plant and thereby maintain maximum allowable reservoir levels and operating heads. Much of the benefit assignable to the pump-turbine unit results from the higher operating head which will be maintained on unit No. 1. Therefore, the existing unit plus the reversible unit will contribute the greatest possible plant generating capability at times of system peak loads (Fig. 4).

The increase in plant capability obtained by use of the reversible unit will vary throughout the winter reservoir filling period and will be greatest during years of low stream flow. In late December there may be no gain in capacity at Hiwassee because the operating head will be controlled by the rate of reservoir drawdown. However, the pumping function will permit longer operation of the Hiwassee installation at full output and will correspondingly shorten the duration of peak output required at other tributary plants, thereby minimizing their drawdown and loss of head, with an overall gain in the available capacity of the system. The advantage of the pump-turbine installation becomes progressively greater through the winter months, reaching 44,000 kw by March 1 in a dry year.

A complete analysis and evaluation of the effect of the reversible unit in relation to system capacity is highly complex. Economic justification can be demonstrated, however, by limiting the capacity benefit to the gain in capacity in mid-January under dry-year conditions. On this conservative basis a conventional unit would add 47,000 kw to the dependable system capability, while the reversible unit will add 55,500 kw—an advantage of 8,500 kw.

Although the present one-unit installation is capable of developing most of the energy potentially available on an annual basis, more than half the energy during the high-load months is necessarily off-peak generation. The installation of more generating capacity will increase the average annual output somewhat, but the most significant gain will be in terms of increased on-peak energy during the high-load months. The reversible unit will increase both the annual and the on-peak output of the

FIG. 3. Operation of Hiwassee installation is typical of that of TVA major tributary, or high-dam, storage projects. In this type of project ample releases for power are usually available during summer and fall drawdown. Available plant capacity during winter months for comparable installations is also shown.



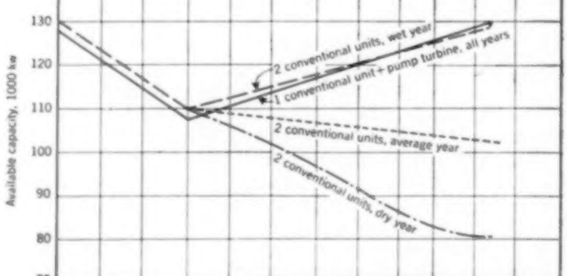
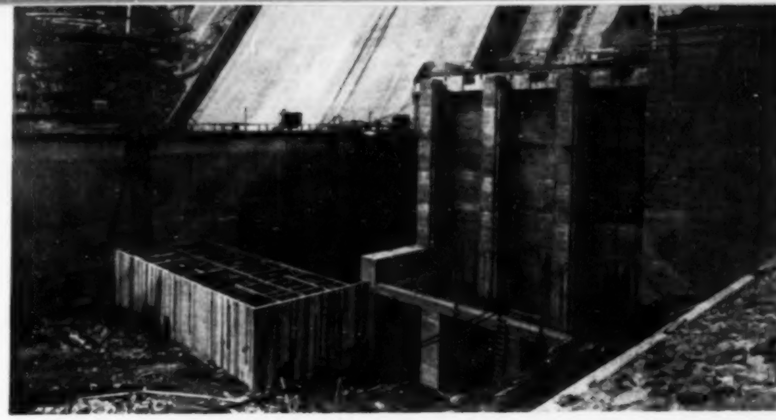


TABLE 1. Estimated combined energy output for Hiwassee and Apalachia plants, in millions of kwhr

	Present Instal-lation	Conven-tional Unit Added	Revers-ible Unit Added
Nov.-Apr.:			
On-peak	135	169	184
Off-peak	146	155	125
Subtotal	281	324	309
Rest of Year:			
Unclassified	451	411	452
Total annual energy	732	735	761



Excavation for second generating unit, between spillway and unit No. 1, was done during initial construction of project. Decision to use reversible unit will make additional 1.5 ft of rock excavation necessary.

plant by a greater amount than could be obtained by adding a second conventional unit.

For comparative purposes, the estimates for each case in Table 1 are based on plant operation at peak capability for 50 to 60 hours per week during the months of high system load, and operation near best efficiency as limited by flow during the remainder of the year. The off-peak input to the reversible unit, when pumping, is estimated to be about 34 million kwhr, including allowance for transmission losses.

The advantage of the reversible unit in terms of on-peak energy during the winter months is 15 million kwhr. This gain is accompanied by a reduction in off-peak generation of 30 million kwhr. Total generation during the November-April period is less with the reversible unit because a greater part of the stream flow can be stored in the Hiwassee Reservoir during that period for release during the summer and fall months. This is reflected also in the increase of 41 million kwhr of unclassified energy. The overall energy gain assignable to the reversible unit is 26 million kwhr.

The installation of either a conventional or a reversible unit would provide additional generating capacity at a favorable unit cost as compared with other possible sources. The economic justification of the reversible unit is, therefore, limited to a benefit-cost comparison with a conventional installation.

The initial cost of installing a reversible unit is estimated to be about 26 percent more than for a conventional unit. Operation and maintenance costs are expected to be somewhat greater. The cost of off-peak pumping energy was evaluated at the cost of incremental steam-power generation. Unit values applied to dependable capacity and various classes of energy were developed from experienced costs and related power rates.

A summary of the costs and of those benefits susceptible to conservative evaluation showed that the reversible unit would provide a margin of about $40,000 in net annual benefits. Other known advantages which were not evaluated, such as increased flexibility of system operation and beneficial effect on head and capacity at other plants, strengthen the economic justification of the reversible unit.

Planning investigations of the TVA engineering staff, under C. E. Blee, Chief Engineer, are made under the direction of James S. Bowman, Chief Water Control Planning Engineer, and under the direct supervision of the writers.

Investigations of the characteristics of the prime movers and generating equipment were made in conjunction with C. L. Norris, M. ASME and R. A. Hopkins, M. AIEE, under the supervision of Robert A. Monroe, Chief Design Engineer. Estimates of potential power were prepared under the supervision of D. M. Wood. (Except for those otherwise designated, all the men listed above are Members of ASCE.) W. J. Rheingans and F. E. Jaski, of Allis-Chalmers Manufacturing Co., cooperated in making available research data developed by their organization.

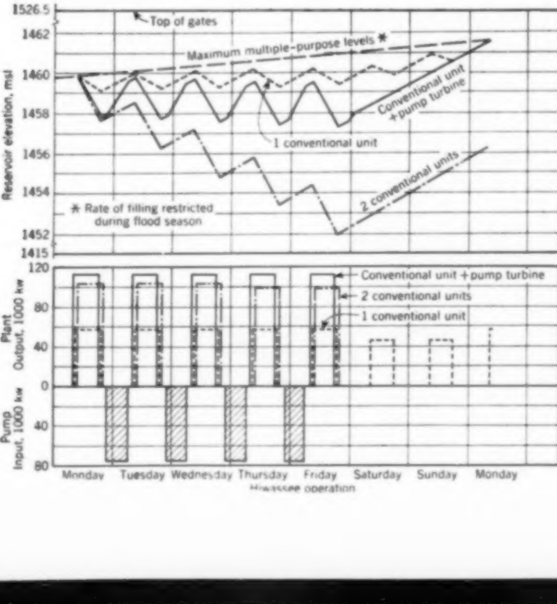
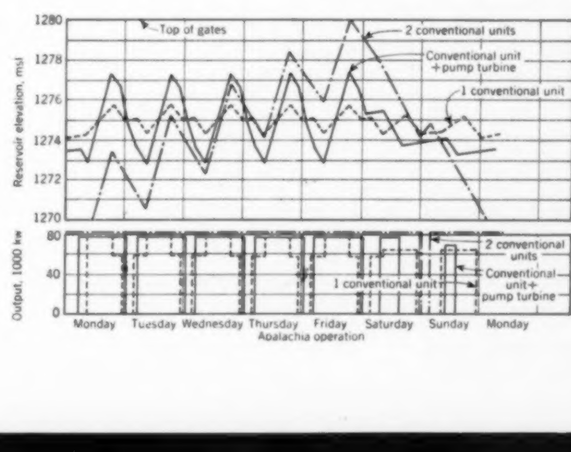


FIG. 4. Typical weekly operation during periods of high system load, for Hiwassee and Apalachia projects, is shown for existing unit, for two conventional units, and for existing unit with pump-turbine.



FIELD HINTS

Miniature current meter fits inside of diamond drill hole to measure flow in limestone cavities

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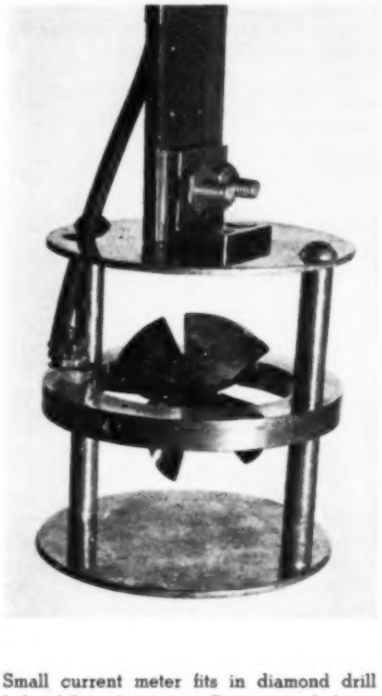
Consulting Engineer, Law-Barrow-Agee Laboratories, Inc., Atlanta, Ga.



Small current meter fits in diamond drill hole of 3-in. diameter. By means of aluminum straps on which it is suspended, meter can easily be turned in direction of greatest velocity.

A knowledge of the flow of water through cavities or caverns in limestone and other rock formations is important to the designer of foundations for bridges, buildings, and dams because moving water can enlarge the caverns and endanger the structure. In the past it has been difficult to measure the velocity of flow in underground caverns except by drilling a pit or shaft large enough to admit a standard-size current meter. Unfortunately the sinking of such shafts is very expensive and requires special equipment.

To obtain flow information at a reasonable cost, a small current meter has been designed which will fit inside the standard NX diamond drill hole (of 3-in. diameter). The meter consists of a small brass propeller mounted on a steel shaft supported by an aluminum frame, as shown in the photograph. A propeller-type meter was selected because it is directional and because it is simple to construct. The meter shaft is steel with needle bearings for greater sensitivity.

The support consists of an aluminum ring 3/16 in. thick that is fitted with the propeller bearings and with an electrical contact that closes once for each propeller revolution. Above and below the ring are aluminum disks that protect the propeller from falling debris and from fouling mud in the bottom of the hole. The meter can be lowered to the proper depth and then turned to point in the direction of maximum velocity. As it is suspended on straps of aluminum, it can be pointed in any direction.

This meter is rugged, compact, and easy to disassemble for cleaning and repair. It is sensitive to velocities as low as 0.1 ft per sec. The entire meter, including the aluminum straps, electric wire, and head-phones and batteries costs less than $50.

How would you do it?

Some of the most fascinating chapters in the life and memory of an engineer are those which deal with the unusual and unexpected situations which almost got him down but from which he finally emerged the victor—H. J. Gilkey

A subway beneath a track elevation bridge often dripped with moisture, especially shortly after a thunder shower. An examination showed that moisture had not found its way through the ballast and the ceiling of the subway. What then was the explanation and can you suggest a relatively inexpensive remedy? For the solution, see page 103.

EDITOR'S NOTE: This is the twelfth installment of a series which started in the February 1952 issue of CIVIL ENGINEERING. In the April issue an article, "The Unexpected in Engineering: The Bugs," explains the project and enlarges upon the central theme that problems of the past created the practice of the present; that "The engineering of today rests upon a coral reef; sturdy remnants of yesterday's bugs." The process is a continuing one; there will always be today's and tomorrow's bugs to add zest and gray hairs to the practice of a profession that by its very nature must cantilever from a codified past to an untried future. "Long live bugs" is an ever-present challenge to the virility and ingenuity of the engineer. If you have a good bug, why not share it? H.J.G.

ENGINEERS' NOTEBOOK

Approximate method determines bridge pier loss

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Flow past bridge piers has long been a problem facing hydraulic engineers engaged in the design of levees, channel improvements, and floodways. Various methods of resolving the water surface elevations at points above and below the structure have been presented, most of which were empirical and not subject to rigorous dimensional or mathematical analysis. In 1939 the Los Angeles District, Corps of Engineers, presented the method here described, which utilizes the momentum principle employed in determining the hydraulic jump.

To attempt a solution to the problem of flow past bridge piers, four basic assumptions must be made:

1. The water surface is level across a section normal to flow.
2. The velocity distribution is reasonably uniform so that the use of mean velocities accurately represents flow phenomena.
3. Friction losses are compensated for by the gravity component of the bottom slope.
4. Air entrainment is negligible.

A cross section of the channel normal to the flow immediately above the bridge piers is shown in Fig. 1, and a longitudinal section along the center line of the channel in Fig. 2. Ordinarily the water surface elevations are required at three locations: (1) immediately upstream, (2) under the bridge, and (3) immediately downstream.

Analyzing Sections 1 and 2 as shown in Fig. 3, let:

M_1 = total hydrostatic pressure of flow at Sect. 1

M_2 = total hydrostatic pressure of flow at Sect. 2

M_o = total hydrostatic pressure of flow replaced by obstruction with area = A_o

Utilizing Newton's first law we find, assuming t = 1 second, that

$$\frac{Q}{g}(V_2 - V_1) = M_1 - M_2 - M_o \quad (1)$$

or

$$\frac{QV_2}{g} + M_2 = \frac{QV_1}{g} + M_1 - M_o \quad (2)$$

Substituting $V_2 = \frac{Q}{A_2}$ and $V_1 = \frac{Q}{A_1}$,

$$\frac{Q^2}{gA_2} + M_2 = \frac{Q^2}{gA_1} + M_1 - M_o \quad (3)$$

However, the expression on the right side of Eq. 3 does not reflect the loss of momentum of impact caused by the bridge piers. Based on observations of bridge pier losses made by the Los Angeles District, Corps of Engineers, it was found that the reduction in kinetic momentum is approximately proportional to the ratio of areas of the obstructed and unobstructed channels, or

$$\frac{Q^2}{gA_2} + M_2 = \frac{Q^2}{gA_1}\left(\frac{A_1 - A_o}{A_1}\right) + M_1 - M_o \quad (4)$$

and

$$\frac{Q^2}{gA_2} + M_2 = \frac{Q^2(A_1 - A_o)}{A_1^2} + M_1 - M_o \quad (5)$$

Similarly, an examination of Sections 2 and 3 will give

$$\frac{Q^2}{gA_2} + M_2 = \frac{Q^2}{gA_3} + M_3 - M_o \quad (6)$$

No adjustment of the momentum at Sect. 3 is necessary since the momentum at this section is not reduced by impact.

Equations 5 and 6 cannot easily be solved as presented; therefore several simplifications are introduced. First, the total sum of hydrostatic pressure and momentum for each sec-

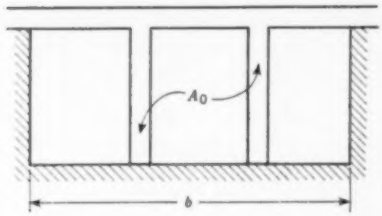


FIG. 1. Cross section of channel normal to flow immediately above bridge piers is shown by diagram.

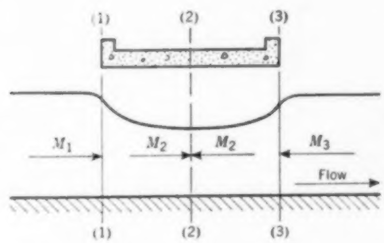


FIG. 2. Longitudinal section along center line of channel indicates three locations: (1) immediately upstream, (2) under bridge, and (3) immediately downstream.

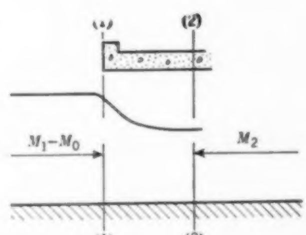


FIG. 3. Sections (1) and (2) from Fig. 2 are shown for purpose of analysis.

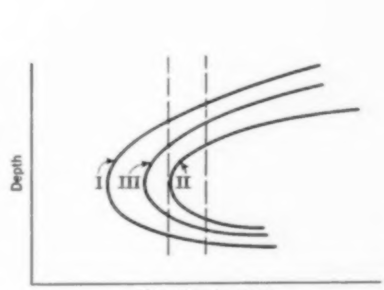


FIG. 4. Curves for Eqs. I, II, and III are plotted using hydrostatic pressure and momentum as abscissa, and depth as ordinate. Vertical line passed through three curves gives solution of Eqs. 5 and 6.

MOMENTUM LOSSES AT BRIDGES

Project ______________ Locality ______________

Q = ________ Sheet ___ of ___ Sheets By ______ Date ______

Section

d	$A_1 = A_3$	$M_1 = M_3$	A_o	M_o	$A_1 - A_o$	$M_1 - M_o$ (1)	$\frac{Q^2}{g(A_1 - A_o)}$ (2)	$\frac{Q^2}{gA_1^2}$	$\frac{Q^2(A_1 - A_o)}{gA_1^2}$ (3)	$\frac{Q^2}{gA_3}$ (4)	I (1)+(3)	II (1)+(2)	III (1)+(4)

M_1 = static moment in unobstructed channel

M_o = static moment of obstruction

$M_1 - M_o$ = static moment in obstructed channel

$M_1 - M_o + \frac{Q^2}{gA_3} = M_1 - M_o + \frac{Q^2}{g(A_1 - A_o)} = M_1 - M_o + \frac{Q^2(A_1 - A_o)}{gA_1^2}$

$\frac{Q^2}{g(A_1 - A_2)}$ = kinetic momentum in obstructed channel

$\frac{Q^2}{gA_1}$ = kinetic momentum in unobstructed channel

$\frac{A_o Q^2}{gA_1^2}$ = kinetic momentum lost

Computation sheet facilitates solution of Eqs. I, II, and III.

tion for equal depths of flow past each section will be determined. Using equal depths, we see that

$M_1 - M_o = M_2 = M_3 - M_o$ and
$A_1 - A_o = A_2 = A_3 - A_o$

and that, for equal depths, the sum of hydrostatic pressure and momentum S, for each section would be

$$S_1 = \frac{Q^2(A_1 - A_o)}{gA_1^2} + M_1 - M_o \quad . \ . \quad \text{Eq. I}$$

$$S_2 = \frac{Q^2}{g(A_1 - A_o)} + M_1 - M_o \quad . \ . \quad \text{Eq. II}$$

$$S_3 = \frac{Q^2}{gA_1} + M_1 - M_o \quad . \ . \ . \ . \ . \quad \text{Eq. III}$$

The values of Eqs. I, II, and III are then determined for various depths, both subcritical and supercritical, as shown on the accompanying computation sheet. A curve using hydrostatic pressure and momentum as the abscissa and depth as the ordinate is plotted for each equation, as shown in Fig. 4. A vertical line passed through the three curves gives a solution of Eqs. 5 and 6.

A vertical line passing through the three curves must intersect a minimum of five depth values, and preferably six, two values each on the upper and lower portions of Curves I and III, and one or two values on Curve II. If only one value is intersected on Curve II, the flow is critical at Sect. 2.

Depth values on the upper portions of Curves I and III are used for subcritical flow, and values on the lower portions are used for supercritical flow. Since backwater computations will determine either a flow depth at Sect. 1 or Sect. 3, depending on the type of flow conditions, the curves give a direct solution to the problem, because the vertical line must pass through the known depth on either Curve I or III and must also pass through Curve II. In the event that this vertical line does not pass through Curve II, it is an indication that the momentum plus pressure of the known depth is too small to pass the flow past the obstruction, and a change in the known or computed flow depth must be made. The flow would then be critical at Section 2, since the critical depth is the depth at which the sum of pressure and momentum is the minimum.

Intersection of two lines computed by simple method

LES CLARKE

Andrews, Clark & Buckley, Consulting Engineers, New York, N.Y.

The following method of computation for the problem of the intersection of two lines has been found to be simple, rapid, and self-checking.

Consider Fig. 1(a), with the following information known:

1. Coordinates of points A, B, C, and D
2. Lengths and bearings of lines AB and CD

It is required to find the lengths of lines AO, OB, CO, and OD, and the coordinates of the point of intersection O.

Referring to Fig. 1(b), the angle of intersection, I, may be computed from the known bearings of lines AB and CD. Constructing perpendicular BM from point B to line CD and dividing BM by the sine of angle I results in the required length BO, and length OA may be computed by subtraction from AB. Similarly in Fig. 1(c), the perpendicular CE divided by the sine of angle I results in the required length CO, and OD may be computed by subtraction from CD. Then setting up a closed traverse run from point A through point O to point D will permit coordination of point O and also prove the accuracy of the lengths established for lines AO, OB, CO, and OD.

The problem of computing the lengths of BM and CE still remains. Consider Fig. 2(a). Here OL and LA represent the latitude and departure, respectively, of point A, and OJ and JB the latitude and departure of point B. Therefore HA and HB are latitude and departure differences between A and B. The angle of bearing of line AF is β, and the direction of the imaginary "hook" line AB is determined by inspection of the coordinates of A and B. Projecting HA and HB on to BM produced, we observe that:

$GM = HK = AH \times \sin \beta$, and

$GB = HB \times \cos \beta$; therefore

$BM = AH \times \sin \beta - HB \times \cos \beta$ (1)

Consider Fig. 2(b), in which OD and DC represent the latitude and departure, respectively, of point C; and AP and PC the latitude and departure differences between points A and C. Projecting AP and PC on to CE, we observe that:

TABLE I. Solution using numerical conditions of Fig. 1 (a)

C	N/ 1,522.633	E/ 1,624.612	N 46-12-00 E (−)/sin = 160.736 = B/O		
B	1,616.745	1,915.899	N 77-31-30 W (+)/sin = 186.137 = C/O		
	94.112 N	E 291.287	I = 56-16-30 sin = .83171195		
O/D	365.350 −	186.137 =	179.213	N 46-12-00 E	
O/A	389.462 −	160.736 =	228.726	N 77-31-30 W	
A				N/ 1,700.874	E/ 1,535.632
O	97639035 S 21601360 C	S 77-31-30 E	228.726	1,651.466	1,758.958
D	72176023 S 69214317 C	N 46-12-00 E	179.213	1,775.508 −.001	1,888.307

Fig. 1 (a)

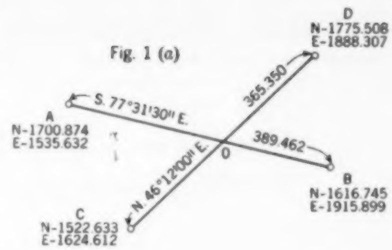


Fig. 1 (b)

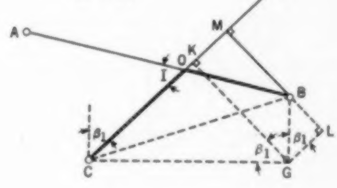
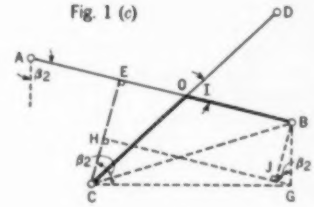


Fig. 1 (c)



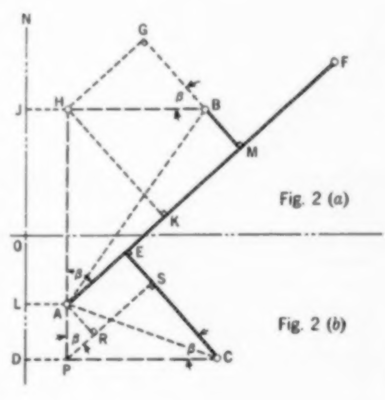


Fig. 2 (a)

Fig. 2 (b)

$AR = ES = AP \times \sin\beta$, and

$SC = PC \times \cos\beta$; therefore

$$EC = AP \times \sin\beta + PC \times \cos\beta \quad (2)$$

Transforming Equations 1 and 2 into general terms:

$$P = L \sin\beta \pm D \cos\beta \quad . \ . \ . (3)$$

where P is the length of a perpendicular from a point to a line, L is the latitude difference, and D the departure difference between the point from which the perpendicular is dropped and a point on the line, β is the angle of bearing of the line on which the perpendicular is dropped, and the plus or minus sign to be applied is determined thus:

Bearing of Hook	Bearing of Line	Sign
N-E or S-W	N-E or S-W	−
	N-W or S-E	+
N-W or S-E	N-E or S-W	+
	N-W or S-E	−

Referring back now to the original problem, from Fig. 1(*b*) we arrive at the equation:

$$BO = \frac{BM}{\sin I} = \frac{LM - LB}{\sin I} = \frac{CG\cos\beta_1 - BG\sin\beta_1}{\sin I} \quad . \ . \ (4)$$

where CG represents the departure difference and BG the latitude difference between the coordinates of points C and B, β_1 is the angle of bearing of line CD, and I is the angle of intersection between the two lines.

From Fig. 1(*c*) we arrive at the equation:

$$CO = \frac{CE}{\sin I} = \frac{CH + HE}{\sin I} = \frac{CG\cos\beta_2 + BG\sin\beta_2}{\sin I} \quad . \ . \ (5)$$

where β_2 is the angle of bearing of line AB and the other quantities are the same as in Eq. 4. Equations 4 and 5 then, furnish a complete solution to the problem.

To illustrate the solution with the numerical conditions in Fig. 1(*a*), refer to Table I, showing the form which the writer has been using successfully for some time. The coordinates of the one point on each of the intersecting lines used to perform the computation, properly identified, are placed in the indicated positions and the latitude and departure differences computed and recorded. The direction of the hook line between the two points is determined by inspection and inserted as shown.

On the same line as the coordinates of each point is recorded the bearing of the line on which that point exists, and the angle I computed and inserted on the same line with the latitude and departure differences. Next to each bearing is then placed a plus or minus sign indicating the form of the equation to be used, and next to the angle I is recorded the value of its sine.

Immediately following the intersection form are outlined the lengths of line which will be computed by subtraction. Then the traverse run is set up, using the coordinates of the points other than those used in the body of the computation, and the lengths determined by subtraction immediately above. The proper bearings and their functions are recorded and all is ready for actual computation. It is to be noted that Equations 4 and 5 were placed in the form:

$$L = \frac{(A \times B) + (C \times D)}{E}$$

which operation is performed in most calculating machines without recording any number other than L, the final answer required.

The computations are now carried through as indicated by Equations 4 and 5, and the computed lengths recorded and identified. The subtractions are then performed, the proper lengths placed in the traverse run, and the run computed in the standard way, the required coordinates of the point of intersection being inserted. A proper closure indicates that all coordinates, bearings, and functions have been copied and used correctly, and all computed lengths are correct. The only possibility of error that then exists in the entire computation is an error of copy of new coordinates, a possibility quickly and easily checked by repetition of the run without any consideration for any other portion of the work.

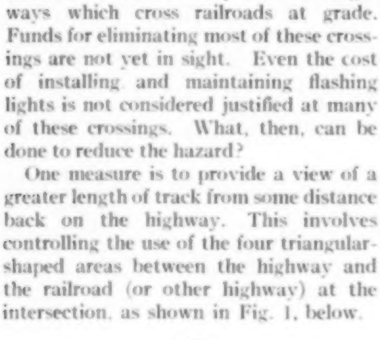
The writer wishes to acknowledge, with gratitude, the information and assistance given so generously by Mr. Thoms, of Levitt and Sons, Inc., Engineering Department.

THE READERS WRITE

Sight Distances at Railroad Crossings Should Be Improved

To The Editor: Perhaps as much as is practicable, short of grade separations, has already been done on heavily traveled highways to make railroad crossings safe, but there are many less used highways which cross railroads at grade. Funds for eliminating most of these crossings are not yet in sight. Even the cost of installing and maintaining flashing lights is not considered justified at many of these crossings. What, then, can be done to reduce the hazard?

One measure is to provide a view of a greater length of track from some distance back on the highway. This involves controlling the use of the four triangular-shaped areas between the highway and the railroad (or other highway) at the intersection, as shown in Fig. 1, below.



HIGHWAY SIGNS
A – Reduce speed, AASHO std
B – Railroad, AASHO standard
C – Cross buck, AREA standard
D – Resume speed, AASHO std

Neither warning signs nor a view of more of the tracks will stop reckless people from endangering themselves and others, but at least the hazard can be reduced even to the reckless, and especially to the innocent. Therefore the taking of additional right-of-way seems justified, particularly where there are no expensive improvements to be removed. Where buildings stand on the land, the factors involved will of course have to be carefully weighed before any action can be taken.

Some states already have begun action to improve sight distances at railroad crossings. Where authority for such action is lacking, a state highway department should take the initiative in persuading the legislature that such authority is desirable. Railroad managements will readily see the advantage of cooperating with highway authorities, and may even initiate action, for accidents at crossings are not only sources of claims, they also cause injury to railroad operating personnel and destruction of valuable property.

It is not necessary to deny all use of the land required for sight distance. Pasture, or low crops generally, would not obstruct the view. Thus a restriction on use would not be excessively expensive, especially in the country. We spend hundreds of millions of dollars for flood control to prevent or lessen damage to property. But we have not yet thought of spending that kind of money to reduce the danger of personal injury, or loss of human life, on our highways.

Hubert E. Snyder, M. ASCE
Managing Director, Toncan Culvert Mfgrs. Assn., Inc.

Cleveland, Ohio

Note: *Mr. Snyder is a member of the ASCE Highway Division's Committee on Developments in Highway Engineering and Construction.*

Prestressed Concrete Poses Both Design and Construction Problems

To the Editor: I have just finished reading with great interest the article by Dr. Newmark in the January issue (p.59), entitled "What We Need to Know About Prestressed Concrete." In his usual thorough and searching manner, Dr. Newmark has crystalized many of the questions relating to design of prestressed concrete. I regret, however, that the title of the article did not include the word "design."

The construction of relatively large structural units is usually accomplished by contract, for which the actual contractor has been selected through competitive bids. It is a long and well established engineering principle that the contract documents contain *all* the requirements the contractor must meet to provide, at the end of his job, a structure closely resembling that visualized by the designer. Similarly well established is the principle of complete inspection and supervision so that it can be reasonably certain at the end of the job that the contractor has complied with the contract plans and specifications. In view of the foregoing, I regret that Dr. Newmark did not include in his article a discussion of contract specifications (as distinguished from building codes), inspection methods, and maintenance.

Until such time as it may be possible to rely completely on the integrity of each workman, many excellent design procedures may be impracticable to transform into closely comparable prototype structures capable of useful service for decades. This observation applies particularly to concrete, the only principal structural material manufactured in the field on the job, and for which it is not uncommon to find a wide variation in strength as shown by such simple things as 6 × 12 concrete cylinders.

To assume that our customary factor of safety will provide for all the above items would be contrary to Dr. Newmark's observations, with which I agree.

Elmer K. Timby, M. ASCE
Howard, Needles, Tammen & Bergendoff

New York, N.Y.

Blast Furnace Slag for Concrete Aggregate

To the Editor: In Mr. MacDonald's article, "Future Development of the Art and Science of Highway Engineering," in the October 1952 issue, he purports to list the most recent research, tests and observations in the general field of highway engineering.

With respect to this list of construction materials, it is noted that no mention is made of *slag* in the category of aggregates. Undoubtedly this was an oversight as it is presumed that Mr. MacDonald is aware of the extensive investigations and research that have been expended on *blast furnace slag* to demonstrate its suitability as an aggregate for highway construction.

As a result of these investigations many technical releases embodying the results obtained have been contributed to the highway engineering profession. Therefore, it seems only reasonable that slag should be accorded recognition in the field of aggregates in any evaluation of the technical contributions to the science of this important phase of engineering.

W. H. Caruthers, M. ASCE
Sales Engineer, Birmingham Slag Co.

Birmingham, Ala.

New Wealth from Irrigation Projects

TO THE EDITOR: The comments in the letter by J. C. Stevens, Past-President ASCE (October issue, page 65), relative to irrigation financing proposals, deal with a subject that is more complex than it might casually appear.

Under the policy announced in decisions by the Supreme Court, each state through which an interstate stream flows is entitled to an equitable share in the flow of the stream. In many cases this requires the construction of expensive irrigation projects if the states are to be able to use their share of the stream flow. This can only be done by government construction of multipurpose projects with resultant benefits to irrigation, power production, flood control, navigation and recreation. For 50 years it has been the established policy of our federal government to lend subsidized support to irrigation development, because it results in new homes for our growing population, and develops a basic resource of the country. At present there is an enormous demand, largely from our war veterans, for land under new irrigation projects. If the lesson taught by all recorded history means anything, only national strength and greatness result from putting areas of fertile land under cultivation. This has been true in our past history as our people spread westward from the Atlantic Ocean. At times there may be surplus agricultural produce for export, but with our growing population and the increasing use of crops for industrial purposes, all-out production will be needed.

During recent years the great increase in construction costs resulted in the proposals for the Basin Account and the Interest Component as additional aid for costly irrigation projects. Mr. Stevens cites the Mountain Home project which, if built as an irrigation enterprise, would cost $1,500 per acre. Irrigated lands in the vicinity of this proposed project are currently yielding a gross annual income of over $100 per acre. At this rate it would only take 15 years of production to recover the initial investment, with the production thereafter being clear national gain.

There is considerable leeway for individual judgment in planning the allocation of costs among the various beneficiaries of these multipurpose projects, and power has not suffered in such allocation. This is evidenced by the fact that rates charged to power users under these government projects have been no greater and generally are less than rates charged by private utilities in the same area.

Our government has to carry on an integrated program for the benefit of all the people—not merely build power plants to deliver power at the lowest possible mill rate to power users. Somebody has to buy the water recorders and various aluminum and other products that are produced on the lower Columbia River. Building up an increased population on the irrigated lands in the tributary area helps to provide such a market. Many products in this country are subsidized by protective tariffs, which are paid by the consumers of goods in the form of increased cost.

Our government has spent billions of dollars in aid to foreign governments, including the building of various irrigation projects abroad, as well as spending great sums for river and harbor improvements at home without any charge to the beneficiaries. It does not appear unreasonable to me for the government to make a very worthwhile capital investment at home to develop our own irrigation projects. These projects will create new wealth many times greater than any estimated construction costs during centuries of useful life.

LYNN CRANDALL, M. ASCE
Snake River Watermaster,
Idaho State Department
of Reclamation

Idaho Falls, Idaho

Irrigation Costs Not Reimbursed to Taxpayers

TO THE EDITOR. Reference is made to the letter by J. C. Stevens, Past President ASCE, in the October issue concerning schemes for financing irrigation projects in the Pacific Northwest. Too little public attention has been given to recent attempts to establish firmly "the Basin Account" and to use "the Interest Component" as an irrigation subsidy. Mr. Stevens is to be commended for explaining these methods, which are being used without the expressed authority of Congress.

Mr. Stevens might also have mentioned in his letter that payments for reimbursable costs of irrigation projects are not reimbursed to the U. S. taxpayer who financed them. They are deposited not in the miscellaneous funds of the U. S. Treasury but in "the Reclamation Fund" to be used again for more projects. In this procedure the taxpayer gets no relief and Congress has little or no control.

All payments of reimbursable costs, including income and interest from electric power projects, should be returned to the miscellaneous funds of the Treasury, and new reclamation projects should require specific authorization by Congress and direct appropriation of funds. Only in this way can the American people, through their elected Congressmen, regain and maintain control of their own economy.

DONALD W. VAN TUYL, A.M. ASCE
Washington, D.C.

Function of Shear Keys in Construction Joints

TO THE EDITOR: Homer M. Hadley's excellent article, "Steel Girders Hung from Concrete Cantilevers" (December 1952), brings up a very interesting and controversial subject—use of shear-keys in construction joints. Of particular interest to me was his dissertation on placing of shear-keys along the vertical-plane construction joint between the cantilever portion of the concrete box girder and the 170-ft span. The logic of Mr. Hadley's reasoning cannot be denied, in that these keys could not conceivably be stressed in vertical shear.

However, it is my contention that although these keys are misnamed "shear-keys," they should be useful and serve a functional purpose. More than half the concrete through a joint of this type is in tension, yet it is not probable that any tensile strength will develop along the construction plane perpendicular to the line of force. Elongation of the tensile reinforcement, upon application of loadings, will doubtlessly cause cracking along this joint, and the reinforcing bars will be exposed to the elements. Yet if adequate keys are placed with rough plane surfaces parallel to the lines of force, some tensile elongation of the concrete will occur. This will reduce the cracking to that usually found in a section of monolithic concrete.

Assuming 0.15 f_c' for tensile cracking and 3,000-psi concrete, 40 sq in. of concrete would be required for each square inch of tensile steel to resist cracking when the steel is under an 18,000-psi stress. This should be the key area, and it is usually available in bridge construction. The key should be formed with a depth of not less than half its width to develop diagonal tensile strength equal to the tensile strength. Properly constructed, keys of this type can serve to prevent cracking even though they are not needed to resist shear, since the shear is zero.

M. SCHWARTZ, J.M.ASCE
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Calif. Div. of Highways
Burlingame, Calif.

SOCIETY NEWS

Varied Program Planned for Miami Beach Convention of ASCE to Be Held in June

It is not too early to make plans to attend the Miami Beach Convention of the Society, for which the Miami Section will be host, June 17–19. The meeting will be the first ASCE Convention in this tropical wonderland, famed as both a winter and summer vacation resort. Between business and technical sessions, members and their families will have many opportunities to sightsee and participate in the unique activities of the area.

Both the Technical Division sessions and the social program, which are being arranged by Section committees, under the general chairmanship of C. F. Wertz, will be full and varied enough to compete with the sightseeing appeal of the locale. Post-convention trips to Havana and Nassau are on the agenda. The technical program, headed by Col. Lynn Perry, will get under way in advance of the Convention proper with a session of the Engineering Mechanics Division, the Society's newest Technical Division, on Tuesday afternoon, June 16. The meetings will continue through Friday afternoon, with every Technical Division sponsoring at least one session.

With Dade County one of the fastest-growing areas in the United States, there are many construction activities in the Miami Beach environs that will be of interest to visiting engineers and will effectively supplement the technical program. Planned field trips include visits to the completed portions of the $208,000,000 Central and South Florida Flood Control Project, the recently completed Cutler plant of the Florida Light & Power Company, the 100,000,000-gpd water-softening plant of the City of Miami, now under construction, and the $27,000,000 Miami sewer project.

Entertainment possibilities, in addition to the planned social program, will include water skiing on Biscayne Bay, a mammoth water show, surf swimming, dancing on moonlit patios, and deepsea fishing. Plans for the visiting ladies call for a boat trip around the fabulous residential islands in the area and a sightseeing tour of such attractions as Hialeah Park, the Fairchild Tropical Gardens, and the Parrot Jungle. There will also be a chance to shop on famous Lincoln Road.

The Casablanca Hotel, on the ocean front, will be the headquarters hotel. Two other ocean-front hotels, the Coronet and the Martinque, have also been chosen to house Convention delegates, and rooms at all three will be available at special convention rates. The Casablanca offers a minimum of 150 rooms at $6 single, $8 double; the Martinque a minimum of 100 rooms at $6 single, $8 double; and the Coronet a minimum of 50 rooms at $5 single, $6 double. Located less than a block apart, all three are completely air-conditioned luxury hotels, each with private beach, swimming pool, and cabana facilities. The convention rates are run-of-the-house, with the exception of penthouse suites, and are good for a few days before and after the Convention for delegates wishing to spend additional time in the Miami area.

If additional rooms are required, they will be readily available at equivalent rates at other hotels in the same block. Reservations for all hotel rooms will be accepted by J. Parker, manager of the Casablanca. The Housing Committee, headed by W. C. Gorman, will release further information and reservation forms in a later issue.

Riviera-like aspects of Miami Beach ocean front are apparent in aerial view (at left) of ocean and luxury hotels. Groynes built to prevent beach erosion are visible. Lincoln Road, famous Miami Beach shopping center, is pictured below.

EJC Takes Steps Toward Expansion at January Meeting

Under provisions of the new constitution of Engineers Joint Council, adopted in December, invitations to affiliate with EJC have been issued to the first seven societies approved by the EJC Board. These steps toward expansion, with the aim of unification of the many societies in the engineering profession in one authoritative body, were reported at the regular monthly meeting of EJC held in New York on January 23. Of the seven organizations invited to join two—the American Society for Engineering Education and the Society of Naval Architects and Marine Engineers—have already accepted and sent representatives to the January meeting.

R. J. S. Pigott

Thomas H. Chilton

The new representatives were formally welcomed into the Council, and one of them, Thorndike Saville of ASEE, was chosen vice-president of EJC in the election of new officers. R. J. S. Pigott, former president of the American Society of Mechanical Engineers and consultant to the Gulf Research and Development Co., was elected president for the coming year. The new executive committee will consist of Carlton S. Proctor, ASCE; W. N. Peirce, AIME; T. G. LeClair, AIEE; and R. P. Kite, AIChE.

In a discussion of labor legislation, ASCE Assistant Secretary E. Lawrence Chandler reviewed the EJC statement of policy made in 1947 and suggested the need for a new statement. It was voted that the president appoint a special committee to review the 1947 statement and to present a modified statement for approval by the executive committee at its meeting on February 20. The president was also instructed to appoint another committee to prepare a program of education on the whole subject of unionization of engineers. EJC will be alert to possible changes affecting the profession in any amendments to the Taft-Hartley Act which may be proposed.

Dr. Thomas H. Chilton, technical director of E. I. du Pont de Nemours & Co., was named chairman of the Engineering Manpower Commission of EJC for 1953, succeeding Carey H. Brown, who had asked to be relieved of the chairmanship. Dr. Chilton was president of the American Institute of Chemical Engineers in 1951 and vice-president of Engineers Joint Council last year.

Council voted also to establish a panel on atomic energy for the purpose of presenting to the Joint Committee on Atomic Energy ideas concerning changes in the Atomic Energy Act of 1946 needed "to encourage ventures by privately owned industries in the atomic energy field." The Joint Committee on Atomic Energy has announced that it will consider such matters in the present session of Congress.

Ralph Tudor Named Under Secretary of the Interior

The hoped-for appointment of engineers to important posts in the new administration is being realized with President Eisenhower's naming of Ralph A. Tudor, M. ASCE, San Francisco consultant, as Under Secretary of the Interior. Mr. Tudor takes to his new post a background of accomplishment in engineering and administration that will be invaluable to the performance of his new reponsibilities with the Department of the Interior, which will range from problems of the Bureau of Reclamation to decisions on matters of the Bureau of Indian Affairs. Secretary of the Interior McKay has announced that Mr. Tudor will be given a free hand "to reshuffle the organization of the Department with an eye to efficiency and economy."

A graduate of the U. S. Military Academy at West Point, class of 1923, with a civil engineering degree from Cornell University in 1925, Mr. Tudor served as an Army officer until 1929. International notice came to him in 1936 as a result of his duties as senior designing engineer for the San Francisco–Oakland Bay Bridge. He was also executive officer for the Golden Gate International Exposition. In World War II he served as a colonel in the Army Corps of Engineers, with a wide range of assignments, and later was vice-president of the Morrison-Knudsen Co. Since 1947 he has headed the Tudor Engineering Co., with offices in San Francisco.

Ralph A. Tudor, M. ASCE (left), and J. G. Wright, president of San Francisco Section, are photographed as they discuss Mr. Tudor's appointment as Under Secretary of the Interior.

A member of ASCE in various grades since 1930, Mr. Tudor has been active in the San Francisco Section and was recently chairman of its Civil Defense Committee.

Air Transport Division Forms New Committee

With recent increases in aircraft size and the consequent need for strengthening runways by placing new pavements over old, the Air Transport Division of the Society has formed a Committee on Design of Overlay Pavements. The primary objective of the new committee is to summarize and evaluate procedures currently in use for the design of such pavements and to report on projected studies aimed at improving present design techniques. Both flexible and rigid overlays will come within the scope of the committee's work. The committee consists of Robert Horonjeff, of the Institute of Transportation and Traffic Engineering at the University of California, chairman; Henry Aaron, chief, Paving and Soils Branch, Civil Aeronautics Administration; Frank M. Mellinger, Ohio River Division Laboratories, Corps of Engineers; L. A. Palmer, chief, Paving and Soils Branch, Bureau of Yards and Docks; and Gerald Pickett, professor of applied mechanics, University of Wisconsin.

The agenda for the first meeting, held in Washington on January 13, consisted of determining the scope of the committee's activities and assigning tasks to the individual members. The committee has been offered the cooperation of the Asphalt Institute and the Portland Cement Association.

ASCE–AIA Joint Cooperative Committee Meets

Attending meeting of ASCE–AIA Joint Cooperative Committee in Louisville, Ky., on February 2 are (seated) Joint Chairmen Craig Hazelet, ASCE, and Leonard Bailey, AIA. Standing, in usual order, are Theodore Coe, AIA; E. N. Purves, AIA; Roy Larson, AIA; G. Brooks Earnest, ASCE (Vice-President); Joseph Ehlers, ASCE (Field Representative); and Alvin Harley, AIA. Meeting was followed by reception attended by officers of Kentucky sections of both organizations. See "From the Nation's Capital" for further details.

New J. Waldo Smith Fellowship Announced

Availability of the J. Waldo Smith Hydraulic Fellowship for the 1953–1954 academic year is announced by the award committee. Granted by the Board of Direction for one academic year of full-time graduate study, the fellowship provides a stipend of $1,000, plus not more than $400 for physical equipment necessary to carry out the proposed research. Applicants should be less than 30 years old, and holders of a fellowship must be either Junior or Associate Members of ASCE. The holder of a fellowship should not accept other "service appointments" or part-time jobs during the academic year of the award.

Administration of the fellowship is in part through the institution which invites cooperation, through its engineering faculty. According to provisions adopted by the Board, the research project should be "in the field of experimental hydraulics as distinguished from that of purely theoretical hydraulics. To this end emphasis is placed on practical experiments [for] advancing knowledge . . . of hydraulic flow, rather than . . . mathematical analysis based on assumptions of unknown validity. The essence . . . of the research is to test the assumptions . . . and also to develop a better understanding of fluid flow." A full, interpretive report of the research should be sent to the Executive Secretary of ASCE before August 31, 1954.

Applications should reach Dr. F. T. Mavis, Chairman, J. Waldo Smith Hydraulic Fellowship Committee, Carnegie Institute of Technology, Pittsburgh 13, Pa., before May 1, 1953. Each applicant should transmit through the dean of graduate studies at the school where he is to study this essential material: (1) Three copies of his letter of application, summarizing his training, experience, and personal data and outlining adequately the research project he proposes to undertake (a recent photograph about 2 × 3 in. should be attached to each copy); (2) three copies of a letter from his major professor or department head appraising his qualifications, professional promise, and proposed research project; (3) one official transcript of his academic record; and (4) one letter from the dean of graduate studies certifying that the applicant is eligible for full-time graduate study during the academic year 1953–1954, and that the proposed research project has proper administrative approval.

Action of the Board of Direction on the fellowship award will be announced by the Executive Secretary in June.

British Engineers Host To Second EUSEC Meeting

The need for the cooperation of engineers and scientists in any successful Atlantic confederation was brought out at a conference of Europe–United States Council of Engineering Societies (EUSEC) held in London, January 12–17, and devoted to engineering education. North American representatives were Dean Willis R. Woolrich, of the University of Texas, who represented the American Society for Engineering Education, of which he is president; Dean Thorndike Saville, of New York University, chairman of the Committee on Engineering College Accreditation of the Engineers Council for Professional Development; and Col. L. F. Grant, of Canada, ECPD chairman. Three practicing engineers and engineering educators likewise represented each of nine other nations—Norway, Sweden, Denmark, Belgium, Netherlands, France, Switzerland, Italy, and Great Britain. The hosts were the Institutions of Civil, Mechanical, and Electrical Engineers of Great Britain.

In reporting the meeting, Dean Woolrich stated that the sessions, "ironed out many misconceptions as to the status and education of engineers in the countries represented. We developed a greatly increased appreciation of each other's problems and achievements," he noted. Much time was spent in defining educational and engineering terms that differ widely in meaning from country to country. The need for a standard international terminology for engineering education was brought out in all the sessions.

EUSEC has sponsored one previous conference. This gathering, held in the Netherlands two years ago, was devoted to problems of management.

Copies of Special Design Curves Made Available

A limited supply of an 18 by $27^1/_2$-in. copy of "Special Design Curves" has been reproduced by photo-offset and is offered for sale. This set of curves supplements Proceedings Separate No. 165—"Special Design Curves for Anchored Steel Sheet-piling," by W. C. Boyer and H. M. Lummis, III—and contains a much reduced reproduction of that Separate for the guidance of those wishing to discuss it. Copies of the special curves, identified as C-165, may be purchased for $1 each from Society headquarters.

EJC Manpower Commission Announces 1953 Program

Industrial production and expansion, hampered for the past two years by a serious shortage of engineers and scientists, will continue to be handicapped in 1953 in efforts to attain full output of both civilian and defense materials according to T. A. Marshall, Jr., executive secretary of the Engineering Manpower Commission of Engineers Joint Council. Mr. Marshall expressed this opinion during a recent meeting with manpower authorities.

In reviewing EMC plans for 1953 to combat the shortage of engineers and scientists, Mr. Marshall declared that "Right now, there is a need for 40,000 new engineering graduates for industrial and civilian governmental needs alone without considering the needs of the military services or education. The grim facts on engineering graduates for the next four years estimate graduates at 23,000 in 1953; at 19,000 in 1954; at 22,000 in 1955; and at 29,000 in 1956."

The EMC program for 1953 calls for the following:

1. Doing everything possible to secure better utilization of engineers and scientists by industry and government—specifically by (*a*) striving for better allocation of engineers between the military, educational, and industrial segments of the economy in order to maintain optimum activity in all three; (*b*) continuing to advocate the establishment of committees or panels to advise the Selective Service System, Department of Defense, etc., on the allocation and use of engineering and scientific manpower; and (*c*) studying the feasibility of using technical institute graduates and those not completing engineering courses in the colleges, rather than engineering graduates, in billets and jobs requiring the training of technicians only.

2. Urging determination of the requirements for engineers as such in the various military services, including determination of the effect of ROTC policies on the supply and utilization of engineers.

3. Initiating an active program to encourage and facilitate the return to engineering positions in industry of engineering graduates leaving military service after terms of active duty.

4. Recommending amendment of the Armed Services Reserve Act of 1952 (P.L. 476), with a view toward providing for a properly balanced allocation of persons having special proficiency and experience.

5. Continuing the program of interesting qualified high school students in careers in engineering and science.

6. Providing assistance to various activities requiring information on the engineering manpower situation. This will include aid in obtaining outstanding and well-qualified persons as speakers.

To carry out these objectives close contact will be maintained with such agencies as the U.S. Office of Education, the National Security Resources Board, the National Research Council, the Armed Services Committees of the House and Senate, the Defense Manpower Administration, and numerous other agencies concerned with manpower policies and problems affecting engineers and scientists.

Metropolitan Juniors Offer Refresher Course

To aid young engineers in preparing for Part III of the New York State Professional License Examination, the Junior Branch of the Metropolitan Section is again offering a refresher course. The next P.E. examination will be given on June 22 and 23 in New York City and other designated locations in the state.

The subject matter to be included in the review course will be Engineering Economics and Practice, Sanitary Engineering and Hydraulics, Structures, and Surveying. There will be ten sessions, to be held in the Board Room at ASCE headquarters, Friday evenings from 6:30 to 9:00 p.m., beginning March 20. The cost of the complete course, including copies of past P.E. examinations and lecture notes, will be $10 to members of the Founder Societies and $20 to non-members. Application forms may be obtained from Prof. Joseph S. Ward, Department of Civil Engineering, the Cooper Union, New York 3, N. Y.

ASCE Honored by Danish Engineers

ASCE receives special royal porcelain plaque from Institution of Danish Civil Engineers of Copenhagen in honor of its recent Centennial celebration. The commemorative stoneware relief, depicting the bringing of fire to the earth by Prometheus, is presented by Poul A. Christensen (left), president of American Society of Danish Engineers, and received by ASCE Past-President Carlton S. Proctor. The ceremony was held in the Engineers Club in New York.

Manual No. 32 Adopted as American Standard

The American Standards Association has approved the Society's most recent Manual of Engineering Practice—the newly issued Manual No. 32, entitled *Building Code Requirements for Excavations and Foundations*—as an American Standard. The 28-page code includes minimum requirements for excavations with reference to safety of structure or permanence of foundations, soil-bearing capacities, extent and proportion of footings and foundations, and recommendations for piling and allowable pile loads. It is considered of particular value for small municipalities interested in building code requirements for excavations and foundations.

Developed through the procedures of ASA by its Committee A56 and sponsored by ASCE, the newly approved code is the culmination of more than fourteen years of work. William H. Mueser, M. ASCE, is chairman of Committee A56.

Manual No. 32 (identified also as A56.1-1952) may be purchased from either ASCE headquarters, 33 West 39th Street, New York 18, N.Y., or from the American Standards Association, 70 East 45th Street, New York 17, N.Y. It is priced at 80 cents a copy, with the usual 50 percent discount available to Society members.

FROM THE NATION'S CAPITAL

JOSEPH H. EHLERS, M. ASCE — Field Representative ASCE

Legislation

It is premature to give even a progress report on legislation now being considered in Congress that is of interest to the profession or to predict the fate of any of the bills mentioned in this column last month.

One measure of great interest that has recently become law provides for an extension of the Reorganization Act of 1949 for another two years. (Public Law 3—Feb 11, 1953). An attempt was made to revise the law to make it easier for Congress to defeat such proposals, but the new law, as finally enacted, requires a full majority of the members of either House of Congress to veto a proposed presidential plan. Indications are that several new plans now under study will become effective. Some reorganization may come about through direct legislation rather than through the presidential action authorized under this law. For example, a bill was recently introduced in the Senate to abolish the Reconstruction Finance Corporation. Other lesser steps toward reorganizing the government can be effected by simple departmental action.

Foreign affairs and reduced spending have been given top priority by both Congressional leaders and the Chief Executive. Construction as well as other expenditures must be clearly essential to be undertaken. Major cuts are not expected but any unessential projects which passed earlier screenings will be subjected to some further review before contracts are let. This may simply mean a temporary easing in new contract lettings with a consequent spreading of the war orders and building over a longer period. The huge atomic energy program is not due for any curtailment.

Policies governing A-E contracts made with the U.S. Department of Defense are summarized briefly in an item in the February issue (page 66) entitled "Policies Governing A-E Contracts Made Public." These policies are described in an article by John P. H. Perry, M. ASCE, Deputy for Installations, Office of the Assistant Secretary of the Air Force (Materiel). Printed copies of Mr. Perry's article and "Uniform Standards for the Employment and Payment of Architect-Engineer Services," adopted in July 1952 by the Department of Defense, suitably bound, will be made available to interested persons upon application to the Editor of "Civil Engineering," 33 West 39th Street, New York 18, N.Y.

Joint Committee with Architects

The ASCE-AIA National Joint Cooperative Committee met in Louisville on February 2 for a discussion of matters of mutual concern to engineers and architects, under the leadership of the two co-chairmen, Craig P. Hazelet, of Louisville, for ASCE and Leonard Bailey, of Oklahoma City, for AIA. Pending problems were thoroughly thrashed out.

This Joint Committee is of paramount importance for, in the field of construction and public works, civil engineers and architects are viewed by legislators and officials of the Executive Departments as a single entity—the design element for construction. It would be disastrous for these two leading groups to present divergent views on the many matters in which they are both interested, such as methods of engaging professional services, controls on construction, reorganization of the Executive Departments or legislation benefiting the professions. In view of the far-reaching consequences of joint action by engineers and architects, a few details of the discussions are presented.

The current situation relating to the methods of engaging professional services, concerning which difficulties have arisen with several government departments, was examined and the recommendation made for a further joint conference of the chairmen of the appropriate committees of ASCE, AIA and NSPE to reconcile any possible divergencies in their views. Problems of contract renegotiation were also discussed.

The disagreements that had arisen between engineers and architects under the registration laws in two states were reviewed. The Joint Committee had been in correspondence with the local groups involved in a disagreement in Louisiana and is continuing to take an active interest in encouraging an amicable settlement.

A check was made of the institutions at which there are Student Chapters of both ASCE and AIA—over twenty in number. Suggestions were submitted for possible joint activities at the Student Chapter level in these institutions. Staff action to follow up these ideas was recommended.

Some suggested government reorganization proposals were discussed, particularly those relating to housing and public works.

A discussion of the subject of professional appointments to top-level government positions dealing with engineering and architecture brought out the fact that ASCE is vitally interested in having engineers designated for engineering positions; on the other hand AIA considered the attitude of the incumbent toward private architects as of greater significance than the nature of his training.

Pending developments relating to cooperation of the two societies with the Construction Industry Advisory Council and other groups and committees sponsored by the Chamber of Commerce of the United States were reviewed. ASCE and AIA have generally alternated in providing leadership in these groups. Continued participation in the Advisory Council as it is now being reorganized was viewed favorably. There was agreement that our two professional groups should play a more active part in the organization and operations of groups in the specific field of public works.

An Interim Committee consisting of the co-chairmen and the co-secretaries was set up to serve in the intervals between formal meetings of the Joint Committee.

ASCE MEMBERSHIP AS OF FEBRUARY 9, 1953

Members	8,277
Associate Members	10,447
Junior Members	17,025
Affiliates	68
Honorary Members	42
Total	35,859
(February 11, 1952	34,206)

Miscellaneous Notes

Top engineer appointment in the new administration in addition to the Secretary of Defense was that of Ralph Tudor, California consulting engineer and an active participant in the work of the San Francisco Section of the Society (see page 67).

The Controlled Materials Plan has been modified so that producers of the critical metals, after they have honored CMP tickets, may take on as many additional orders as they can handle. Realistically speaking, this suggests the "early orderly abandonment of the Controlled Materials Plan" which various industry groups have strongly urged.

The Renegotiation Board has issued regulations clarifying the renegotiation of hydroelectric power construction contracts. The regulation appearing in the February 5 issue of the Federal Register specifies certain power projects of the Corps of Engineers and the Bureau of Reclamation that are subject to renegotiation. Renegotiation Staff Bulletin No. 12, "Guide for Renegotiation of Construction and Architect-Engineer Contracts," continues to be the basic guide for engineering firms having renegotiable contracts.

Washington, D.C.
February 19, 1953

George Washington University Chapter Is Host to Large Prestressed Concrete Conference

Crowds estimated at 500 engineers and builders watches test loading of prototype prestressed concrete beam during all-day Prestressed Concrete Conference sponsored by George Washington University Student Chapter on January 31. Alvin R. Schwab, J.M. ASCE, on staff of Southern Railway Co., and member of District of Columbia Section, arranged and managed the all-day conference, said to be one of the biggest technical meetings ever put on by an ASCE Student Chapter. Speakers, in addition to Mr. Schwab, were Cedric Stainer, Preload Company, Inc., New York; John J. Hogan, Portland Cement Association, New York; and Harold Anson and Jean Muller, Freyssinet Company, Inc., New York. Following morning technical session, conference moved to plant of Arban and Carosi, Inc., contractors on a church project in Arlington, Va., first prestressed concrete building in the Washington area, for test loading of beam. Cooperating with the Chapter in conduct of the conference were the District of Columbia Section of ASCE, Washington-Metropolitan Chapter of AIA; Master Builders' Association, Inc., Expanded Shale Institute, Navy Bureau of Yards and Docks, Office of the Chief of Engineers, Arlington County Department of Building and Inspection, and other technical and government organizations. Material for this write-up was supplied by Edward R. Caldwell, member of George Washington University Student Chapter.

More Local Section Technical Activities Needed

In the special fields represented by the Society's Technical Divisions Local Sections can provide extremely valuable opportunities for members of ASCE. However, considerable unawareness of those opportunities appears to exist. Cooperative technical activities are encouraged by specific policy of the Board of Direction. The Local Section Manual and the Technical Division Manual include special sections devoted to implementation of the policy.

Currently 25 Local Sections have had technical committees in operation. Some have only one technical committee cooperating with the Divisions. Others have several, some even one committee in the field of each Division. In all, there are about 100 such committees which have been in operation, and others are in the process of organization.

In some Sections the technical groups conduct separate meetings or seminars or field trips. An example is the Sanitary Group of the Los Angeles Section, which for 25 years has held successful dinner meetings with all papers relating to developments in the field of sanitary engineering. Another form of activity is illustrated by the Surveying and Mapping Committee of the Seattle Section, which meets at least once each month, and has taken active part in preparing legislation affecting the work of engineers in this field of interest. Both these Local Sections have other technical committees with similar activities.

A third pattern displays a separate committee working with each one of the 13 Technical Divisions of ASCE. An example is the San Francisco Section, which has found its organization of technical specialties most valuable in arranging for a national convention, as well as on a continuing basis. Some of these committees work cooperatively with other organizations, such as the Construction Group with the AGC.

An excellent example of constructive work on a rather informal scale is found in the Junior Branch of the Metropolitan Section. Recognizing that programs for a large Section, with members having a wide range of interests, must be pretty general in character to attract good attendance, the Junior Members also realized the need for discussion in specific fields. Such discussion they felt, would be "too deep or too narrow to attract general attention at regular meetings" of the Section.

On that thesis, they determined to develop seminars on appropriate subjects. In 1952 a Soil Mechanics Seminar was started. It was given an enthusiastic reception, and the group has met regularly, once a month, throughout the summer and winter. A Sanitary Engineering Seminar began to function in December, and it promises to become equally successful. To date, these groups have been satisfied to confine their activities to oral discussion of problems in their respective fields, but they are looking forward to the probability of producing papers for publication by the Society as formal contributions to technical and professional advancement.

All these are excellent demonstrations of what can be done by members of the Society, regardless of age or grade of membership, who will take advantage of opportunities available within their organization and have the desire to promote their personal development as well as to advance the profession.

The Board of Direction has made no attempt to establish a set pattern, and no such pattern is needed. More members in more Local Sections taking more interest in Society activities of the sort described will strengthen the work of our Technical Divisions and, in like measure, further enhance the technical value of ASCE to its members.

NOTES FROM THE LOCAL SECTIONS

(Copy for these columns must be received by the tenth of the month preceding date of publication.)

Financial problems involved in the publication of "Technical Topics," newsheet of the Akron Council of Engineering and Scientific Societies, were discussed at the January 10 meeting of the **Akron Section** by F. W. Stafford and other Section representatives to the Council. Presentation of certificates of life membership to Oscar Elting and Luther Larue (in absentia) was made by Wendell La Due, who spoke briefly on the contributions of each to the profession and on the advantages of belonging to ASCE.

Junior Members of the **Juneau Subsection** of the **Alaska Section** were represented on the program of the January 20 dinner meeting by a talk on unusual construction features of a public building project in Tokyo, Japan, given by Thomas Shanley. The design and control of asphalt paving mixtures was then discussed with slides by W. K. Boyd. Mr. Boyd is leaving Alaska to accept a position with the U. S. Engineer Department in the states.

The importance of careful planning and study in preparing contractors' plans for bids to assure the client's receiving "the best possible job at least possible cost" was emphasized by Jesse R. Glaeser, project manager for the Perini-Walsh Construction Co., in a talk at the January luncheon meeting of the **Buffalo Section.** Speaking on "Tunnel Construction and Financing of Operations," Mr. Glaeser based his observations on hydraulic tunnel construction for the Ontario Hydroelectric Power Commission project at Queenston, Ontario, on which he is project manager for his firm. New Section officers are Frederick W. Crane, president; John R. Campbell, vice-president; Nathan Schwartzman, secretary; and Bernard R. Fuller, treasurer.

Engineering contributions to the progress of man as a social being were reviewed at the January meeting of the **Central Illinois Section** by J. O. Draffin, professor of theoretical and applied mechanics at the University of Illinois. Paul C. Gauger received his certificate of life membership.

Despite a bad snowstorm, there was a good turnout of **Cincinnati Section** members and their guests for the January 7 meeting to hear Frank C. Tolles, former ASCE Director for District 9, and City Engineer J. T. Montgomery describe proposed plans and plants for the city's sewage treatment. Present plans call for the building of four large disposal plants to serve the entire county (Hamilton). Mr. Tolles delved into the economics of sludge disposal by burning or conversion into fertilizer.

The ultimate dislocation of the steel industry to salt water ports is threatened unless more support can be mustered for the St. Lawrence Seaway Project, Morris A. Bradley, director of public relations for the M. A. Hanna Co., told members of the **Cleveland Section** attending the January 16 dinner meeting. Mr. Bradley discussed the Labrador-Quebec Iron Ore Development project as a case in point because of its inaccessibility. A single-track railroad 365 miles long with sidings every 17 miles is being constructed to bring out the ore, and first shipments are expected in 1953. At the conclusion of the meeting, the following new officers for 1953 were installed: Leslie J. Reardon, president; Mauno Backlond, vice-president; and William P. Auping, secretary-treasurer.

New officers for the **Central Savannah River Valley Subsection** of the **Georgia Section,** elected at the annual meeting on January 22, are Raymond J. Gauger, president; Warren P. Carson, vice-president; and P. J. Masciocchi, secretary-treasurer. The technical program consisted of the showing of a film covering the manufacture of clay products. Questions were answered by Darroh Nowell, chief engineer of Merry Brothers Brick & Tile Co.

An invitation from the San Francisco Section to participate in a District 11 Conference was discussed at length at the January meeting of the **Intermountain Section,** which finally went on record as unanimously favorable to the idea of taking part in such a conference. B. Eugene Brazier, of the Salt Lake City firm of Ashton, Evans & Brazier, gave the address of the evening—on "Engineering and Architecture."

The uses of stereoscopic photography and projection as aids in description and measurement were reviewed at the January meeting of the **Ithaca Section** by Prof. K. B. Jackson, head of the physics department at the University of Toronto, and his assistant, Professor Klawe. Multi-camera projections, viewed both with and without the aid of polarized spectacles, captivated the capacity audience. Much of the meeting was devoted to business discussion.

"World Oil and Peace" was the topic of discussion at the January 13 meeting of the **Kansas City Section,** with Marlin M. Volz, dean of the Law School at the University of Kansas City, the principal speaker. By means of graphs and charts, Dr. Volz indicated that the free countries now hold and control 93 percent of the total oil supply of the world. The great risk to world peace, he said, is in the strategic location of the vast oil reserves in the Middle East.

New Secretary of the Interior Douglas McKay (left) leads off battery of speakers for annual dinner of the District of Columbia Section on February 10. In usual order, others are: Nathan W. Dougherty, dean of University of Tennessee College of Engineering; ASCE Vice-President Edmund Friedman, Miami, Fla.; and Section President Vincent B. Smith. Dean Dougherty gave the principal address of the evening on the outlook for engineering unity. In an unrehearsed message to the 280 men and women at the dinner, Secretary McKay stressed his high regard for engineers and assured his hearers that the new administration intends to push the nation's conservation, reclamation, and irrigation programs as vigorously as in the past. Other dinner guests of the Section were ASCE Director Carl G. Paulsen, Executive Secretary William N. Carey, Washington Representative Joseph H. Ehlers, Maryland Section President William B. Spencer, and Virginia Section President John W. Roberts.

View of head table at annual dinner meeting of Northeastern Section, held in Boston on January 26, shows (in usual order) Prof. J. B. Wilbur, new vice-president of Section; Mrs. Wilbur; O. S. Bray, retiring Section president; Mrs. Bray; Howard M. Turner, new Section president; Mrs. Turner; and Prof. E. L. Spencer, reelected secretary-treasurer. Retiring President Bray briefly reviewed year's activities and presented certificates of life membership to six Section members—Frank M. Gunby, Ralph W. Horne, Victor J. Mill, Paul Norton, Walter C. Voss, and Edward Wright. Other recipients, unable to attend meeting, are Allan S. Beale, C. J. Gooch, Ralph I. McCorkindale, and Harold A. Sweetland.

Recent scientific developments, their impact on society, and possible future scientific developments were dealt with in a talk entitled "Where To," given by H. H. Downing, retired head of the department of mathematics and astronomy at the University of Kentucky, at the January 19 meeting of the **Kentucky Section**—the occasion of the annual luncheon with the Kentucky Society of Professional Engineers.

To take advantage of the presence on the West Coast of Dr. Elio D'Appolonia, associate professor of civil engineering at Carnegie Institute of Technology, a special meeting of the ASCE Soil Mechanics Group in the **Los Angeles Section** was called. Dr. D'Appolonia spoke on "Loose Sands Compacted by Vibroflotation," illustrating his talk by movies of the vibroflotation project of the International Minerals and Chemical Corp., at Bonnie, Fla. (January issue, page 84). The Los Angeles Section boasts several active technical discussion groups.

The **Metropolitan Section** is establishing an award that will recognize "exceptional service to the engineering profession in the New York–New Jersey metropolitan area during the preceding calendar year, which resulted in unusual distinction to the member, the Section, and the Society." It is hoped that the award will also make the public more generally aware of the contributions of the profession to the metropolitan area. The recipient of the award will be known as "Metropolitan Civil Engineer of the Year" and will receive a suitably engraved certificate from the President at the annual business meeting of the Section. Qualifications, in addition to service of "unusual distinction," are ASCE membership in the grade of Member or Associate Member and membership in good standing in the Section for the five years preceding the award.

Low-cost protection of structures against atomic bomb attack was the theme of the technical program for the January 5 meeting of the **Miami Section** entitled "Engineering in Civil Defense." Jules P. Channing, chairman of the engineering division, Dade County Defense Council, dwelt on the effects of the bomb on structures and on the provision of shelter areas in existing buildings and in the design of new buildings. He said that the addition of about 3 percent to the normal cost of a building would provide shelter areas within the building for all occupants, whereas the cost of new structures designed primarily as shelters would be excessive and the space wasted under normal circumstances.

New officers of the **Memphis Branch** of the **Mid-South Section,** elected at its annual dinner meeting on January 9, are James R. Newman, president; James M. Wood, vice-president; and Jacob McBride, Jr., secretary-treasurer. For the technical program, Lawrence A. Tvedt showed films on the manufacture of steel and the erection of the Golden Gate Bridge. At a luncheon meeting on January 20, the **Vicksburg Branch** elected its new officers—Donald Coe, president; J. F. Redus, Jr., vice-president; and Milton L. Williams, secretary-treasurer.

At the request of the Michigan State Registration Board, members of the **Michigan Section** are providing questions for the professional section of the Examination for Registered Professional Engineers.

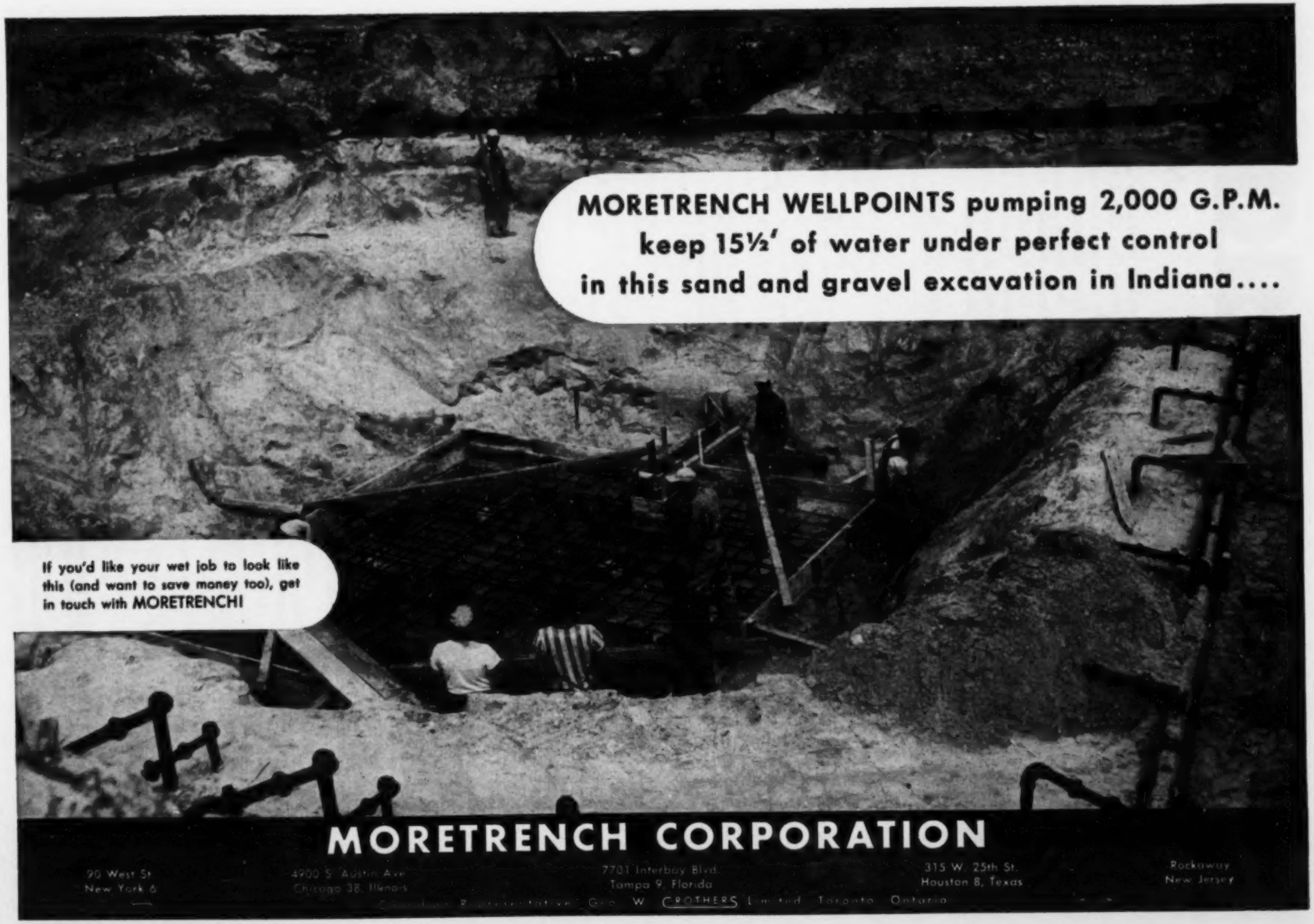
The **Nebraska Section** recently sent representatives to the state legislature to oppose a pending bill calling for creation of a highway commission. A Section resolution unanimously approved at the January 21 meeting calls the bill, which would establish a seven-member commission and provide for appointment of a business manager, "unwise legislation in its present form." In the proposed set-up, the business manager and state engineer would have overlapping responsibilities, with the state engineer's role in the proposed commission mainly technical. Speaking at the Section's January 21 meeting, State Engineer Harold Aitken came out against the truck tolerance bill now before the legislature. The bill calls for a 5 per-cent tolerance above the state's present 18,000-lb load for each axle and the total permitted load of 64,650 lb. "It should be obvious, even to non-engineers," he said, "that most of Nebraska's blacktop highways were not designed to carry even present loads."

Army navigation and flood control structures in the Twin City area were discussed at a joint dinner meeting of the **Northwestern Section** and the Twin City branch of the Society of American Military Engineers on January 28. The speaker was Col. Delbert B. Freeman, division engineer for the Upper Mississippi Valley Division of the Corps of Engineers. During the business meeting, Thomas Klingel was unanimously elected second vice-president of the Section to succeed Paul Thomas, who is moving from the area.

The civil engineering department at the Duke College of Engineering was host to the all-day winter meeting of the **North Carolina Section** in Durham on February 6. The attendance of engineers from all over the state included Student Chapter members from North Carolina State College and students in the University of North Carolina School of Public Health. Technical sessions featured talks by Dr. George Glockler, director of chemical sciences at the Office of Ordnance Research on the Duke campus; Dr. Daniel A. Okun, associate professor of sanitary engineering in the University of North Carolina School of Public Health; and K. K. Kirwan, chief engineer, Centriline Corp., New York City. Life membership certificates were given to Lloyd M. Ross and Richard Pfaehler.

New **Oklahoma Section** officers are Harold B. Wenzel, president; Roger L. Flanders, vice-president; and Wayne F. Davis, secretary-treasurer. The **Tulsa Branch** will have Will W. Wheeler for chairman, and Jack Cornett for secretary-treasurer. Woodrow W. Baker is 1953 chairman of the **Oklahoma City Branch,** and David M. MacAlpine, secretary-treasurer.

Honors for the **Philadelphia Section** in the form of a Certificate of Award, from the mayor expressing appreciation of its work done in a building survey for civilian defense! As a result of the survey, 50 percent of which was performed by civil engineers, Philadelphia has more information on available facilities for shelters than any other city. "Soil Mechanics and Foundations" was the theme of the Section's January meeting, with Prof. Benjamin K. Huff pinchhitting at the last minute for the scheduled speaker, O. J. Porter, who was suddenly called out of the country. Professor Huff, who is in charge of the soil engineering laboratory at Cornell University and co-developer of a new process for treating soils, explained how unfavorable sites may be made suitable for major building foundations by chemical treatment. The **Delaware Subsection's** January meeting program was also devoted to soil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Oregon Section Honors

Its New Life Members

Oregon Section members receive life membership certificates at Section's annual banquet from Guy H. Taylor. At left is James H. Polhemus, president of Portland General Electric, and in middle John L. Franzen, Salem city manager. Third recipient Roy F. Bessey, is abroad. New Section officers, elected during meeting, are H. Loren Thompson, president; Kenneth Phillips, first vice-president; Gordon L. Burt, second vice-president; and Bob Bonney, secretary-treasurer. Speaker of evening was George W. Gleeson, dean of School of Engineering at Oregon State College, who outlined "Resources for Freedom."

mechanics, with Philip P. Rutledge, of the New York firm of Moran, Proctor, Mueser & Rutledge, the principal speaker.

ASCE officers—Vice-President Edmund Friedman and Director George W. McAlpin—reviewed Society affairs for the benefit of **Pittsburgh Section** members at their January 27 meeting. New officers, installed during the meeting, are F. T. Mavis, president, and William A. Conwell, vice-president. W. R. B. Froehlich remains as secretary-treasurer. Life membership certificates were presented to Alfred M. Danzilli, William C. Edgar, Philip A. Franklin, and Earl B. Woodin.

Practical aspects of Arctic navigation and piloting were discussed at the **Providence Section's** annual winter dinner meeting on January 8 by Capt. Frederick W. Laing, U.S. Navy. Captain Laing, who is also professor of naval science at Brown University, drew on interesting personal experiences for his talk.

The **San Francisco Section** has scrapped its bulletin in favor of a striking new publication—18 by 11-in. format, coated paper, and color—with a new name, "The Civil Engineer." Volume 1, No. 1 of the enlarged publication, which made its appearance in February, discusses reasons for the change and outlines future plans. In addition to the usual meeting announcements and news about members, the new monthly will feature a president's column, Board and committee activities, Junior Forum functions, news of the Speakers' Club and the Legislative Council, Special news items, and a calendar of events. R. D. Dewell is editor.

Student Chapter members at the University of South Carolina, Clemson College, and the Citadel swelled attendance at the **South Carolina Section's** all-day annual meeting held in Columbia on January 23. The principal speakers were Dr. Leonard Niedrach, of the Knolls Atomic Power Laboratories, Schenectady, N.Y., and J. H. Stephens, chief of the Division of Sanitary Engineering, South Carolina State Board of Health. During the business meeting the following officers were elected for 1953: H. O'B. Bellinger, president; I. A. Trively, vice-president; and Albert E. Johnson, secretary-treasurer.

The need for state participation in water policies was stressed at the December dinner meeting of the **San Antonio Branch** of the **Texas Section** by Brig. Gen. Henry Hutchins, Jr., consulting engineer and retired Army officer. General Hutchins pointed out that there is a void between federal appropriations for flood control and use of storage water in Texas, and that to bridge the gap the state should be permitted to finance the cost of flood control dams and later sell the impounded waters. Col. H. R. Hallock, district engineer for the Corps of Engineers at Forth Worth, described his experiences in military construction in Europe, South America, and Hawaii at the January luncheon meeting of the **Forth Worth Branch.**

Opportunities for the engineer in civil service and public service were outlined at the **Wisconsin Section's** annual meeting in December by Volmer H. Sorensen, director of the Wisconsin Bureau of Personnel. George A. Sievers, industrial consultant and psychologist, then described "Scientific Methods of Classifying Engineering Positions and Salaries" and urged action on the part of engineers to correct inequities in salary and job classification. Certificates of life membership were given to A. L. Hambrecht and to Sylvester C. Baker.

Coming Events

Central Ohio—Meeting in Columbus, Ohio, on March 19.

District of Columbia—Meeting at the Cosmos Club auditorium on March 10. Meetings of the Junior Forum on the fourth Wednesday of each month.

Florida—Section will act as host to meeting of the District 10 Council at Jacksonville, Fla., on March 27 and 28.

Ithaca—Dinner meeting at the Willard Straight Hall, Cornell University, on March 10 at 6:30 p.m. Main program in East Lounge at 8 p.m.

Maryland—Dinner meeting and cocktail hour at the Engineers Club, Baltimore, on March 11 at 6 p.m.

Metropolitan—Meeting in the auditorium of the Engineering Societies Building, 33 West 39th St., New York, N.Y., on March 18 at 7 p.m. The **Junior Branch** meets in the ASCE Board Room at the same address on March 11 and 25, at 7:30 p.m.

Philadelphia—Meeting at the Engineers' Club, March 10. **Central Pennsylvania Subsection** will meet in the Commonwealth's North Office Building in Harrisburg, Pa., on March 11 at 7:45 p.m.

Pittsburgh—Joint meeting with the Civil Section of Engineering Society of Western Pennsylvania at the William Penn Hotel on March 10, at 8 p.m.

Providence—Meetings are held in the Providence Engineering Society auditorium on the second Thursday of each month at 8 p.m.

Sacramento—Weekly luncheon meetings at the Elks Temple every Tuesday, at 12 noon.

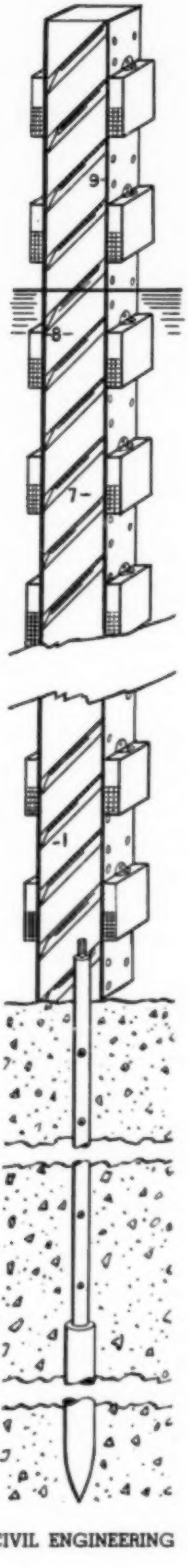
Scheduled ASCE Conventions

MIAMI BEACH CONVENTION
Casablanca Hotel
June 17–19, 1953

NEW YORK CONVENTION
Hotel Statler
October 19–23 1953

ATLANTA CONVENTION
Hotel Biltmore
February 15–19, 1954

HYDROGRAPHY



('Round The Clock . . . 'Round The Calendar)

WITH NO ONE PRESENT!

Now . . . ONE Instrument—the *HydRobot*—that Measures

SCOUR • MAXIMUM WATER STAGE
MAXIMUM WATER VELOCITY • DURATION OF FLOW

The *HydRobot* Consists of:

1—Scour Depth Recorder—NOW . . . practicable for the first time . . . an instrument to determine scour—to any degree deemed necessary.

DESCRIPTION:

RETURNS SAMPLE OF NEW MATERIAL REPLACING SCOUR

Scour Depth Recorder is a retainer rod perforated at regular intervals with a small, light ball in each perforation. It is driven into the stream bed surrounded by a tubular casing. The anchor point of the retainer rod will allow the retainer rod to remain at depth of penetration while the casing is withdrawn. Any scouring or lateral displacement of subsurface material will displace the ball at that level. When the stream bed at point of placement is to be checked for scour, the casing again is driven over the retainer rod and the entire unit withdrawn. Perforations still retaining balls are at an elevation (at that point of placement) not reached by scour. Perforations minus the ball will contain samples of redeposited material.

2—Maximum Water Stage Gage—Will record maximum water stage at point of placement and retain recording until read.

DESCRIPTION:

SIMPLE COMPUTATION WITH OTHER INSTRUMENTS WILL GIVE DISCHARGE RATE

Maximum Water Stage Gage is a 3 x 4" timber in which slots have been cut at a 45° angle from horizontal and 45° vertical angle from face toward back. The inverse face of each slot is covered with a water-soluble paint. The inverse face is completely protected from rain, windstorm or any other water except that of the water stage rising and filling the slot from below. Metal side strips protect the gage from drifts. The outer face of the Maximum Water Stage Gage is graduated to 0.01 ft.

3—Maximum Velocity Recorder—(Current Meter). Will measure maximum velocity at every elevation at which set, retaining measurement until read.

DESCRIPTION:

WITH FLOW-DURATION RECORDER, CAN CHECK TOTAL RUNOFF

Maximum Velocity Recorder is a pendulum device that will displace upward in an arc relative to the force of the water velocity. A ratchet and dog will retain the pendulum at the maximum point of deflection. These instruments may be placed at intervals of 3 per foot to record the maximum velocity of each stage.

4—Duration-of-Flow Recorder—Will record length of time instrument was subjected to water flow relative to lower stages, and relative to velocity recorded at same stage by maximum Velocity Recorder.

DESCRIPTION:

Duration-of-Flow Recorder is a Pelton Wheel effect that revolves at a speed relative to velocity recorded on Maximum Velocity Recorder, geared down so that 10 RPS will permit it to accumulate a recording for approximately *10 MONTHS.*

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DEVELOPERS OF Fusible-Metal Power Couplings • Angle-Retentive Instruments for Surveying and Navigation • Thermo Controls for Electronic Instruments

NEWS BRIEFS . . .

Road Builders Stress Need for Highway Funds at Annual Meeting of ARBA

America's leading roadbuilders gathered in Boston last month for the 1953 annual meeting of the American Road Builders Association and, like the walrus and the carpenter, spoke of many things. The subjects discussed ranged from rubber in bituminous pavements to trends in rigid pavement design, from the equipment outlook for 1953 to federal labor regulations. But most prominent of all was a subject that has been discussed many times before and without doubt will be discussed for years to come—"Where to find the elusive highway dollars."

R. M. Reindollar

Charles M. Ziegler, president of the American Association of State Highway Officials, pointed to the need for militant action. He said that, "Federally collected gasoline, oil and excise taxes from cars, tires and parts during the past calendar year exceeded $1,800,000,000. Even with increased appropriations of federal-aid for highways, an amount equal to less than one-third of the above figure was appropriated for return to the states during each of the next two fiscal years."

Mr. Ziegler also pointed a finger at the 26 states which diverted, "nearly $267,000,000 dollars of funds intended for highway purposes" [Bureau of Public Roads figures]. "This was an increase in diversion of 23 percent over 1950." He also noted that, "Highways are not expendable in time of war and, therefore, must be considered in defense plans. Our highways have become part of the assembly lines producing war material, ammunition, aeroplanes, tanks and heavy moving equipment."

The defense aspects of an adequate highway net were further emphasized by Brig. Gen. P. F. Yount, Deputy Chief of Transportation, U.S. Army, who said "Restricted bridges must be replaced with modern structures, the system must be constructed with limited or controlled access throughout so as to preserve it for the efficient and effective movement of essential defense traffic, and the method of financing its improvement to uniform standards must insure that all states correct major deficiencies and raise the level of design of both rural and urban sections with comparable effectiveness."

Toll roads were inevitably brought into the discussion when Senator Edward Martin of Pennsylvania noted that "Revenues from publicly owned toll roads and crossings in 1951 amounted to more than $155,000,000. Receipts from new and expanded toll roads and bridges will increase the receipts from that source in 1952 to more than $187,000,000.

"It is important to note," the senator continued, "that at least 23 states have enacted some type of toll-road legislation, and it is expected that about 2,000 miles of toll highways will be in operation in the country within the next two years." Senator Martin echoed other speakers when he stated that, "The federal gasoline tax is levied on the highway user, and none of it should be diverted into the general fund."

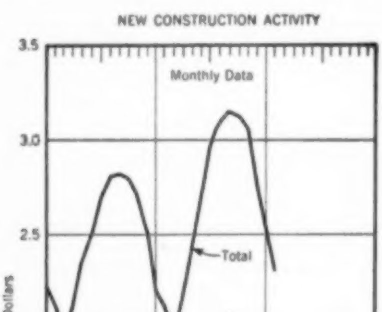
Reduction in federal construction expenditures announced by the administration will not mean curtailment of federal aid to highways as now authorized by Congress, Hon. George H. Fallon of Maryland, ranking minority member of the House Subcommittee on Roads, told a meeting of the Contractors' Division.

The Congressman pointed out that the present needs of the 664,000 miles of the federal-aid system required an expenditure of over $32 billion and additional deficiencies are reported daily.

The new president of the ARBA, elected at this meeting is Robert M. Reindollar, M. ASCE, consulting engineer of Baltimore, Md. Prior to establishing a consulting practice in 1951, Mr. Reindollar was connected with the State Roads Commission of Maryland for forty years. The four regional vice-presidents elected at the meeting are Charles M. Noble, M. ASCE, Trenton, N.J.; W. G. Pruett, Montgomery, Ala.; Julien R. Steelman, Milwaukee, Wis.; and Harmer E. Davis, A.M. ASCE, Berkeley, Calif.

Construction Activity in January Is Above Year-Ago Level

Construction activity continued at record high levels during January 1953, according to preliminary estimates of the U.S. Labor Department's Bureau of Labor Statistics and the Building Materials Division of the U.S. Department of Commerce. Despite a seasonal decline of 8 percent from December, the total value of new construction put in place during the month amounted to more than $2.3 billion, 6 percent above January 1952. This marks the fourteenth consecutive month that the current total has exceeded that for the comparable month in the previous year.



Despite seasonal drop of 8 percent from December, construction activity during January exceeded year-ago level by 6 percent, Department of Commerce curves show.

The high level of activity during January 1953 largely reflects substantial increases from January last year in private residential building, plus gains in private commercial building and in major types of public construction.

Expenditures for privately financed construction put in place in January totaled $1,623 million, 9 percent less than in December and 7 percent above January 1952 expenditures. The December-January decline in private work resulted largely from the usual mid-winter lull in private housebuilding. Private outlays on public-utility construction were also down seasonally in January, but industrial and commercial construction held at the December level.

Seasonal declines from December in all types of public work brought total public construction expenditures for January to $685 million, 5 percent under December. Nevertheless, the dollar volume of public construction was 4 percent higher this January than in the comparable month a year ago because of greater outlays for all classes of public work except housing, hospital building, and federal conservation and development work.

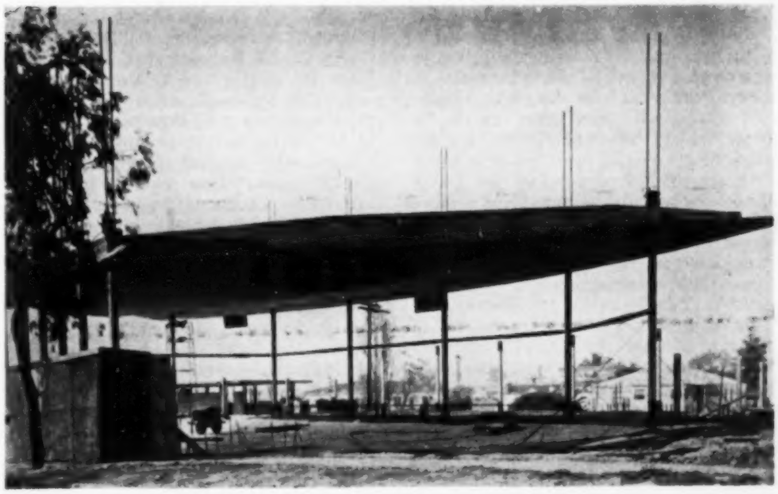
Plans for Superstructure Of Thruway Bridge Revised

Work on the superstructure of the New York State Thruway's Tappan Zee Bridge between South Nyack and Tarrytown will get under way shortly following revision of plans in favor of a cantilever truss for the main span instead of the tied-arch formerly planned. The Authority advertised for bids on the entire superstructure, including a tied-arch center span, for letting on December 15, but no bids were received. The Authority then decided to divide the superstructure work into several contracts, and to substitute a centilever truss for the tied-arch center span. Plans for the alternate design had been started several months earlier when the driving of test piles in the river revealed much better subsurface conditions than were originally expected. The Authority believes that the cantilever truss center span will be easier to erect and less expensive than the tied arch.

A low bid of $3,182,265 has now been received from the American Bridge Division of the U.S. Steel Corp., for the construction of 1.6 miles of steel superstructure, including railing, on previously constructed concrete abutments and bents on the western half of the bridge. The contract for this first portion of the superstructure work will be awarded shortly to the American Bridge Division. Another bid—a low bid of $1,031,470—has been received from the Construction Aggregates Corp., of New York City, for the construction of ten reinforced concrete rigid-frame bents to serve as foundation for 0.1 mile of the bridge's center section. The second bid will complete the foundation work on the structure. Three substructure contracts totaling about $19,000,000 were let at various times during 1952.

All of the superstructure work is expected to be under contract this spring, and the bridge is scheduled for completion late in 1954.

New Lifting Method Expedites Heavy Roof Construction



Heavy roof of new Los Angeles church, weighing nearly 1,000,000 lb, is literally floated through air into place by unique new process called Lift-Slab Method. Lifting was accomplished by hydraulic jacks of 50-ton capacity set atop twelve columns supporting the pie-shaped concrete slab. The jacks raised threaded rods fastened to collars around the columns. When in position the record-breaking slab was supported on 3/4-in. plates bolted to column flanges. Columns were then encased in concrete fireproofing and the collars grouted in. Structural design, including design of slabs and collars, was by Brandow & Johnson, Los Angeles structural engineers, and contractor was Zimmer Construction Co., Los Angeles. Vagtborg Lift-Slab Corp., of West Los Angeles, accomplished the lifting.

UNESCO Technical Assistance Program to Continue in 1953

The chief contribution of UNESCO to the Technical Assistance Program in 1953, based on requests from foreign governments themselves, will be to continue to encourage the development of carefully planned national programs in technical education, as well as scientific research and teaching. Much of the expense of the regional fundamental educational centers in Mexico and Egypt is financed by Technical Assistance funds, as are educational missions to member states.

UNESCO has requested $5,500,000 for its Technical Assistance Program in 1953—some $2,000,000 more than was expended in 1952. The program as planned is mainly a continuation of projects already started.

Floating Bridge Recommended For Puget Sound Crossing

A plan for the bridging of Puget Sound in the vicinity of Seattle has been sent to the Governor by the Washington Toll Bridge Authority. Four possible crossings (Fig. 1) were studied and presented, with the Authority recommending the southernmost crossing referred to as Route 1.

The structures included in the recommended route are: (1) a 15,497-ft bridge over the East Passage of Puget Sound, which includes 11,666.5 ft of floating structure; (2) a 3,400-ft suspended span over Colvos Passage (3) a fill and bridge structure over Sinclair Inlet; and (4) a 1,200-ft suspended span over Rich Passage. This route would connect Seattle with Bremerton and provide access to both Bainbridge and Vashon Islands. The report estimates a bond issue of $82,000,000 will be required to finance the recommended structures and connecting highway.

Charles E. Andrew, M. ASCE, is chief consulting engineer to the Authority, and John J. Parcel, Ralph A. Tudor, and Ralph Smillie, Members ASCE, constitute the Advisory Consulting Engineering Board.

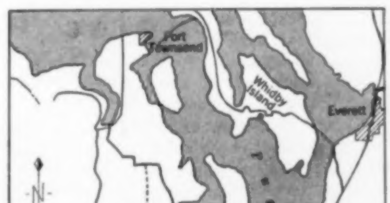


FIG. 1. Four possible Puget Sound crossings are indicated here. Southernmost crossing, called Route 1, is recommended by Washington Toll Bridge Authority.

Engineers Study San Diego Sewerage Problem

Results of a year-long engineering survey of the problems involved in the collection, treatment, and disposal of San Diego County sewage—authorized by the county in August 1951—have been issued by the San Diego County Sewerage Survey in a 500-page report covering every phase of the investigation. For purposes of the survey, the county was divided into three sewerage areas delineated by economic as well as topographic considerations. The designated areas are the San Diego Bay, North Coastal, and Mountain-Desert.

For the San Diego area, the recommendations of the engineering board call for the adoption of Core Plan Al, as representing "the best and most economical solution of the sewerage problems. Under this plan, sewage from the entire area would be conveyed to a primary-type treatment plant to be located on the west side of Point Loma, preferably in the Fort Rosecrans Military Reservation and, after treatment, dispersed in the Pacific Ocean." Recommendations call for the City of San Diego, "as the largest political entity and the largest contributor of sewage," to construct and operate the basic facilities called for in the plan. Other recommendations urge that the surrounding area, after formation into eight county sanitation districts, purchase capacity rights in the core system and contract with the city for payment of the cost of maintaining and operating the joint facilities.

Recommendations for the North Coastal area call for the formation of eight county sanitation districts to include all areas currently requiring sewerage. Four of these districts, embracing the Del Mar, Solana Beach, Cardiff, Encinitas, Leucadia, Rancho Santa Fe, and Escondido areas, would cooperate in the construction and operation of an oxidation pond-type treatment plant to be located in the upper end of Elijo Lagoon, with disposal of effluent into the Pacific Ocean. Two other districts, embracing the Carlsbad, Oceanside, and Vista areas, would join together in the construction and operation of an oxidation pond-type treatment plant to be located near the upper end of Agua Hedionda Lagoon. Effluent from this plant would also be disposed of in the Pacific Ocean. Remaining districts, including the Fallbrook and Ramona areas, would continue to use existing facilities.

With respect to the Mountain-Desert Area, it is recommended that the community of Campo continue to use the existing treatment plant, and that steps be taken to provide sewerage facilities for the communities of Alpine and Julian in accordance with present plans of the County Department of Public Works. Other communities in the area are held to be not currently in need of sewerage facilities.

The group's study of the possibilities of reclaiming water from sewage led to the recommendation that the existing treatment plants of the cities of Chula Vista, El Cajon, and San Diego be modified and improved to permit the reclamation of about 15 mgd of water for irrigation use. In so far as practicable, the effluent from the two proposed treatment works for the North Coastal Area should also be used for irrigation purposes.

The board of consulting engineers for the San Diego County Sewerage Survey consists of ASCE Vice-President A M Rawn, chairman; Charles Gilman Hyde, Hon. M. ASCE; and David H. Caldwell, A.M. ASCE. Frank J. Kersnar, J.M. ASCE, is principal assistant engineer for the Survey. Inquiries concerning the report should be addressed to the San Diego County Sewerage Survey, 4005 Rosecrans Street, Building 8, San Diego 10, Calif.

Prizes Open for Papers On Resistance Welding

Cash prizes totaling $2,500 will be awarded in 1953 by the Resistance Welder Manufacturers' Association for outstanding papers dealing with resistance welding subjects. The awards are divided into three categories, with prizes totaling $1,500 for the three best papers emanating from an industrial source, that is consulting engineer, private or government laboratory, or the like; $500 for the two best papers submitted by university staff members; and $250 for the best paper coming from a university undergraduate.

The contest closes July 31, 1953, and awards will be made at the 1953 fall meeting of the American Welding Society, joint sponsor of the contest. Papers should be sent to the American Welding Society, 33 West 39th Street, New York 18, N.Y.—in triplicate if mailed to arrive before July 1. Otherwise, six copies should be furnished.

Moles Present Their 1953 Construction

Nearly 1,100 members and guests of the Moles, national organization of heavy construction men, attended its thirteenth annual award dinner, held at the Waldorf-Astoria in New York, February 4, to join in honoring Peter Kiewit and Edward P. Palmer, M. ASCE, for "outstanding achievement in construction." Considered the highest recognition for distinguished service to the American construction industry, the awards are given annually to one member and one non-member of the Moles.

Mr. Kiewit, winner of the non-member award, is president of Peter Kiewit Sons' Company, of Omaha, Nebr., major contractor in the building of the Air Force's new Arctic Base at Thule, Greenland, and recently awarded a $1.2 billion contract for the new AEC plant at Portsmouth, Ohio. Mr. Palmer, a life member of ASCE and recipient of the Moles member award, is president of the New York City firm of Senior & Palmer. He was described as having had more to do with building subways and deep bridge foundations in and around New York than any other man and as a pioneer in underwater installations made with the aid of compressed-air chambers.

The presentations to Messrs. Kiewit and Palmer were made by George Ferris, vice-president of the Moles, and J. Rich Steers, respectively. In their responses, both gave

Chicago Reorganizes Its Public Works Department

Numerous changes have been made in the set-up and personnel of the Chicago Department of Public Works, which was reorganized January 1. Virgil E. Gunlock, M. ASCE, has been appointed Commissioner of Public Works in charge of the reorganized department. He was formerly Commissioner of the City Department of Subways and Superhighways.

The organization of the various bureaus in the department will remain the same except in the new Bureau of Engineering, which will perform the planning, engineering design, and construction of all capital improvements. It is headed by Dick Van Gorp, A.M. ASCE, former chief engineer of the Department of Subways and Superhighways, as chief engineer. Under him are three assistant chief engineers heading administration, design, and construction activities. They are Fred G. Gordon (administration), Walter E. Rasmus (design), and J. Walter Grimm (construction). All are members of ASCE. Other divisions of the new Bureau of Engineering involving ASCE members are the Filtration Design Division, with George S. Salter as chief filtration engineer, and the Advance Sewer Planning Division, with A. L. Tholin as chief sewer engineer.

Other changes involve the creation of a new Department of Water and Sewers, which will take over all activities in connection with the operation and maintenance of the Chicago Water Works System and the Chicago Sewer System, formerly in the Department of Public Works. Activities pertaining to the design and construction of water works, sewers, bridges, subways, expressways, viaducts, parking garages, streets and lighting, remain in the Department of Public Works in the Bureau of Engineering. Design and construction of the water-distribution system will be retained in the Water Distribution Division of the Bureau of Water of the Department of Water and Sewers. The department has two bureaus—a Bureau of Water and a Bureau of Sewers. The Bureau of Water will be under the direction of Deputy Commissioner for Water and Chief Water Engineer W. W. DeBerard, Hon. M. ASCE, former city engineer. John R. Baylis, A.M. ASCE, will be engineer of water purification, heading the Water Purification Division, one of six divisions under Mr. DeBerard. The Bureau of Sewers is under the direction of Deputy Commissioner for Sewers Thomas D. Garry, former superintendent of sewers. A. J. Schafmayer, M. ASCE, is chief engineer of sewers under him.

Prestressed Concrete Conferences Scheduled

To keep engineers, architects, contractors, and manufacturers abreast of developments in the rapidly expanding field of prestressed concrete, the Newark College of Engineering under the sponsorship of the Portland Cement Association is offering a series of eight conferences on the subject. William S. La Londe, Jr., M. ASCE, chairman of the civil engineering department, will be conference coordinator, and the two-hour programs will cover a wide range of new developments and applications presented by experts in the field. The conferences will be held Monday and Thursday evenings, 7:30 to 9:30 p.m., beginning April 6.

AEC Selects New Plant Location in Illinois

Selection of a site on the Spoon River in Fulton County, Illinois, for a new explosives processing and assembly plant is announced by the U.S. Atomic Energy Commission. The location chosen, which is about 18 miles east of Macomb, Ill., is the former site of Camp Ellis in World War II, and the General Services Administration is transferring some 9,800 acres of government-owned land to the AEC. The new project, which will be named the Spoon River Plant, will not manufacture radioactive material.

Construction of the plant, estimated to cost about $29,000,000, will begin in the early spring. A new engineering office to supervise construction will be established soon, with W. A. Curtis, chief of the Production Planning Branch of the Santa Fe Operations Office, project engineer in charge of construction for the AEC. The Fluor Corporation, Ltd., of Los Angeles, is architect-engineer for the project. Most of the construction work will be on a lump-sum, competitive bid basis, and some 2,000 construction workers will be required by the fall of 1953.

Awards at Annual Dinner

major credit for their achievements to their co-workers. President David Bonner and A. Holmes Crimmins, chairman of the Award Committee, also spoke, emphasizing the distinguished company the new award winners are joining—a company that includes Herbert Hoover, Gen. Brehon Somervell, the late Frank Crowe, and Robert Moses.

In the principal speech of the evening, T. Keith Glennan, president of Case Institute of Technology, Cleveland, and former member of the Atomic Energy Commission, said that the United States has now invested $12 billion in atomic energy production facilities, and that it "must decide very soon whether it will keep this vast undertaking a government monopoly for military purposes or open it up for development in constructive ways by private industries." Big business monopoly is bad, but government monopoly is worse, Dr. Glennan declared.

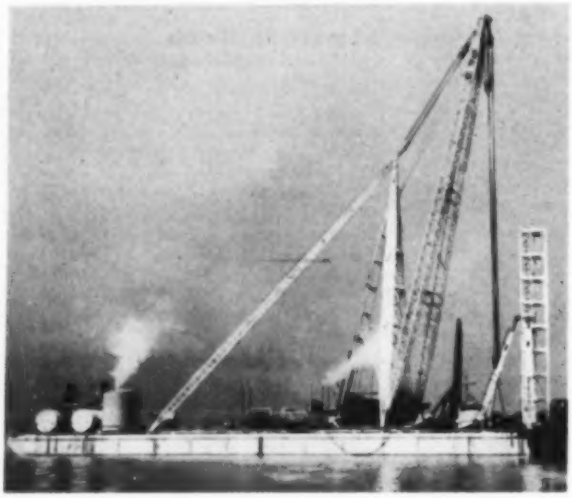
Notables seated on dais at Moles' annual award dinner in New York are Harry T. Immerman, Guy C. Kiddoo, Chester W. Cunningham, James A. Farley, Stephen D. Bechtel, Gen. Lewis A. Pick, Frank M. Groves, Arthur S. Horner, Algot F. Johnson, Gen. S. D. Sturgis, Jr., George F. Ferris, Peter Kiewit, Dr. T. Keith Glennan, David Bonner, A. Holmes Crimmins, Edward P. Palmer, J. Rich Steers, James F. Armstrong, Richard E. Dougherty, Rear Admiral Joseph F. Jelley, George L. Freeman, Col. F. J. C. Dresser, Lester S. Corey, William A. Klinger, Michael J. Madigan, W. N. Carey, Howard P. Maxton, and Charles E. Simmons. Arriving after photo was taken were I. V. A. Huie and R. W. Atwater.

High-Tensile-Strength Bolts Used in Erection of 200-Ton Derrick and Pile Driver Leads

Walter W. Redy, J.M. ASCE, Avondale Marine Ways, Inc., Avondale, La.

Successful application of high-tensile-strength bolts on a derrick-barge project recently constructed by Avondale Marine Ways, Inc., bears out the results of extensive research in the use of such bolts that has been under way in the past few years.

The welded barge, which is to be used for driving piles in Lake Maracaibo, Venezuela, is 210 by 70 by $13^1/_2$ ft, with a total hull weight of 825 tons. It was built to receive a 200-ton derrick and an adjustable 80-ft pile-driver lead and equipped with the entire power plant necessary to operate the project for the Creole Petroleum Corporation of Venezuela. The derrick and pile-driver leads were purchased from the American Hoist & Derrick Co., assembled with high-tensile-strength bolts, and erected by Avondale Marine Ways, Inc. Gross weight of the derrick and pile-driver structure was 245 and 58 tons, respectively, exclusive of the machinery required for operation.



Welded barge—equipped with adjustable pile-driver leads and 200-ton derrick, assembled with high-tensile-strength bolts—is ready for handling piles in Lake Maracaibo, Venezuela.

All bolts used were 1-in., ranging from $2^1/_4$ to 5 in. long. The washers were carburized, quenched, and tempered—hardness 65–70 Rockwell A, minimum depth 0.015 in. The bolts had to develop a strength of 42,500 lb to resist shear load through friction at the faying surfaces. Since 3,500 bolts were required for the project, it was necessary to plan a production schedule combining speed with exactness to save time and money.

Use of power wrenches was decided upon. The general procedure employed first called for cleaning the faying surfaces of loose scale, burrs, pits, and other defects preventing solid seating of all parts and to develop maximum friction. The high-strength bolts were then installed with a hardened washer under the head and nut, and tightened to approximate clamping force by use of impact wrenches. With constant air pressure required to pull the bolts to 42,500 lb, a small air-receiver tank with a pressure regulator and gauge was used to maintain the volume of air at constant pressure for feeding each individual power wrench.

On completion of each splice joint, the bolts were tightened to the correct amount of torque by use of a torque wrench. Care was taken to note the reading while the nut was still turning on the bolt—an important precaution because of the difference between the static and sliding coefficients of friction.

On this specific project, it was found that the high-tensile-strength bolts: (1) Eliminate the need of body-bound bolts, which necessitate perfect field alignment, reaming of holes, and snug fitting bolts; (2) stay tight longer than rivets; (3) are more economical than riveting, especially in field erection; and (4) are easily replaced where riveting equipment is not readily available.

Prefabricated Structures Speed Building of Greenland Air Base

World's largest salt-water distillation plant is under construction at Thule Air Base, new United States Air Force base in northern Greenland. Twelve of the service buildings at the huge base, including the 31,968-sq ft, three building distillation plant, are standardized steel-frame structures fabricated 2,600 miles from the site by the Luria Engineering Co., of Bethlehem, Pa. Each of the three distillation buildings is 148 ft long, with 72-ft spans and 16-ft eave heights. Engineers on the project, which is located 910 miles from the North Pole, were Metcalf & Eddy of Boston, and the architects, Alfred Hopkins & Associates of New York. The base was built by the North Atlantic Constructors, an organization of contractors. U.S. Army Photo.

1952 Housing Starts Four Percent Above 1951 Total

A total of 1,131,300 new permanent nonfarm dwelling units were started during 1952, of which 1,074,300 were privately owned, according to preliminary estimates of the U.S. Labor Department's Bureau of Labor Statistics. Marking the fourth consecutive year that housing starts have exceeded the million mark nationally, the 1952 estimate represents an increase of 40,000 units, or 4 percent, above the 1951 total, and was exceeded only by the record established in 1950 with 1,396,000 unit-starts.

Housing starts declined less than seasonally from November to December 1952—by 11 percent to 76,000 units, an increase of 25 percent over the December 1951 figure. Early reports to the Bureau indi-

cate that December housebuilding activity declined in varying degrees in all sections of the country except the West South Central region where there was a moderate increase.

The housing volume was influenced partly by a gradual easing of restrictions on the use of building materials and the relaxation of mortgage-credit controls. Private housing alone accounted for the higher level of housebuilding in 1952—increasing by 54,200 units, or 5 percent, over 1951. The volume of public housing was lower during the year by 14,200 units. Final estimates available for the first nine months of 1952 indicate gains over 1951 in the volume of one- and two-family units, but new apartment construction continued the decline that began in 1951.

Large Contracts to Expand Idaho Operations of AEC

Contract awards for construction at the National Reactor Testing Station during 1953 are expected to total about $12,000,000, according to Allan C. Johnson, director of the Division of Engineering and Construction at the Idaho Operations Office of the Atomic Energy Commission.

Addressing members of the Idaho Chapter of the Associated General Contractors at their recent annual meeting in Boise, Mr. Johnson described the two major construction contracts, which are for ground-testing facilities for a prototype aircraft propulsion reactor. He noted that the first of these contracts, to be awarded this spring and estimated to total about $6,000,000, will be the second largest lump-sum contract let by the AEC since its inception. The second large contract for the aircraft project to be awarded in 1953, construction of an engine test area, will total about $5,000,000, Mr. Johnson told the group.

College Graduates Reach New Salary Heights

Although American industry is offering recent college graduates higher salaries than ever before, there will still not be enough technical men to meet the demand, according to the seventh annual nationwide survey released by Frank S. Endicott, director of placement at Northwestern University. A study of 176 major corporations in the United States shows that the average starting salary is now $304 a month, a marked increase from the $235 average offered in 1948. According to Mr. Endicott, about 39 percent of the personnel directors in the corporations studied think that present starting salaries are too high "compared with the worth of older employees whose salaries haven't been increased as much as rates for beginning college graduates."

Despite the much publicized shortage of graduating engineers, the companies surveyed hope to employ 25 percent more technical men than they hired last year. One reason for this is the fact that the companies got only 68 percent of the number they wanted last year. To make matters worse, about 75 percent of the graduating college seniors are slated for early induction into the armed services. The companies say, however, that past experience has shown that 83 percent of the college men who enter the armed service after employment will return to the company.

In an effort to meet their needs for more college graduates, representatives of the 176 companies will visit on the average of 20 colleges and universities. Seventeen companies say that they will visit from 50 to 100 campuses, and eleven will get in touch with over 100 schools.

Giant Hydraulic Dredge to Increase Canadian Power

Deepening and widening of Beauharnois Canal, Quebec, to provide the volume of water necessary to operate the expanding facilities of the Quebec Hydroelectric Commission has been started by the new dredge, "Hydro-Quebec," the world's largest hydraulic pipeline dredge. When completed, the Beauharnois installation will be the largest single-site hydroelectric plant in the world, producing more than 2,000,000 hp. The 15-mile Beauharnois Canal between Valleyfield and Beauharnois, Quebec, is the life-line of the Beauharnois Power Plant and will eventually direct the entire flow of the St. Lawrence River. Its 3,300-ft width includes a navigation channel 600 ft wide and 27 ft deep, which will permit passage of ocean-going vessels.

Like the dredges that dug the Panama Canal and now maintain it, the "Hydro-Quebec" was designed by the Ellicott Machine Corp., Baltimore, Md. It has already pumped boulders up to 30 in. in dia and weighing as much as 1,000 lb apiece. With preliminary digging and production trials completed, full-scale operation of the dredge will start in the spring.

In the construction of the giant hydraulic dredge, provision had to be made for reducing its beam to 42 ft to allow passage through the locks of the Lachine and Soulanges canals while en route up the St. Lawrence from the Marine Industries shipyard at Sorel to the canal. The complete dredge hull is 220 ft long, with a 58-ft beam. Power is furnished through a trailing submarine cable that connects, at the shore, to a transmission line from the Beauharnois power house. The connected load of all the dredge's electric motors is 12,800 hp, and the main pump motor has sufficient power to move boulders and other material through the 36-in.-dia discharge line for distances of over a mile.

According to M. L. Duplessis, Prime Minister of Quebec, "The new dredging equipment will help, not only to keep Quebec in the forefront in hydroelectric development among the Canadian provinces, but will assist in maintaining the province's reputation of being able to meet all demands for electric power for any purpose."

"Hydro-Quebec," world's largest hydraulic pipeline dredge, is being towed backwards from launching site to Beauharnios Canal, Quebec, where it recently started work. In this view, the uniquely designed sponson sides have been removed to facilitate passage through the canal locks, and the 400-ton ladder and cutter assembly has not been installed under the A-frame in front. The new dredge can pump 30-in. boulders through a 36-in. discharge line for distances of over a mile.

Compressed Concrete Piles Overcome Settlement at Philadelphia Housing Project

At the site of Philadelphia's $2,300,000 Norris Housing Project, special foundation treatment was needed to prevent undue settlement in fill and silt over decomposed schist. MacArthur compressed concrete piles of 15-in. diameter were selected and two static load tests were made on single piles. The building regulations limited the settlement of each test pile to 0.6 in. Actual settlements recorded for the two piles, 22 ft 6 in. and 27 ft long, under a load of 60 tons, point bearing on the schist, were 0.1875 and 0.3750 in., respectively. The project, which is a start on slum clearance in the area, consists of 68 row-type structures of concrete frame with brick facing and one 11-story apartment building. The foundation problem here described was for this apartment building, for which the MacArthur Concrete Pile Corp. of New York installed 611 piles. The engineers are Gibson & Kline; the architects, Antrim & Etter Associates; and the general contractor, McCloskey & Co., all of Philadelphia, Pa.

N. G. Neare's COLUMN

R. ROBINSON ROWE, M. ASCE

"How shall I rate your literacy, Joe?" asked Professor Neare. "Did you do the problems in literal arithmetic?"

"I picked out one at random and did it so I knew I could do them all," bragged Joe Kerr. "Just looking at

$$E \times TIME = EMIT$$

I saw that to make *time* run backwards, $t = 1$ to make $e \cdot t = e$. Next, if $e \cdot e$ has a units digit $t = 1$, then $e = 1$ or 9, but to be different from t, we must make $e = 9$. The example reduces to:

$$9(1{,}009 + 100i + 10m) = 9{,}001 + 100m + 10i$$

$$\text{or } m = 89i + 8$$

for which the only solution in integers less than 10 is $i = 0$, $m = 8$. So the answer is $9 \cdot 1{,}089 = 9{,}801$."

"I'll bet Joe didn't pick that one at random until he'd given up on all the harder ones!" scoffed Cal Klater. "It's the only set for which one digit is obvious at the start, altho the other palindrome $E \times GULP = PLUG$ yields $4 \cdot 2{,}178 = 8{,}712$ by progressive logic. Because of multiple solutions, the others require cut-and-try techniques, leading to the answers:

VE × ER = ROWE
52 × 21 = 1,092
62 × 21 = 1,302
26 × 61 = 1,586
53 × 31 = 1,643
35 × 51 = 1,785
63 × 31 = 1,953

BO × ER = BAER
16 × 80 = 1,280
29 × 75 = 2,175
26 × 84 = 2,184

FO × FUN = ONION
41 × 437 = 17,917
87 × 810 = 70,470

TE × ANS = PROUD
39 × 402 = 15,678
27 × 594 = 16,038
54 × 297 = 16,038
36 × 495 = 17,820
45 × 396 = 17,820
52 × 367 = 19,084
78 × 345 = 26,910
46 × 715 = 32,890
63 × 927 = 58,401

"I liked the last one; not only are Texans proud in nine different ways, but each multiplication is expressed by the ten arabic digits."

"Pretty thoro, Cal," conceded the Professor. "Did he miss anything, Joe?"

"How would I know? Come to think of it, tho, you asked for the largest product on the '*VE × ER*', which would be 1953, dating the invention."

"I remember now," admitted Cal. "By the way, you said you'd enjoy similar examples; how do you like these:

O × YGEN = XENON . . . . . (1)
VE × ING = MATH . . . . . (2)
O × TAIL = SOUP . . . . . (3)
BO × WOOD = SCALE . . . . (4)
MI × MUD = PIES . . . . . (5)

The second is to be done without a zero, the first without a cyclotron, and the last without any help from junior."

"I'll try them, thanks," said the Professor, "if you'll try the three-factor example,

ARTA × ER × ES = LEADER . . (6)"

[Cal Klaters and problems submitted for next time were: Rudolph W. Meyer (1), S. K. Rueball (Keith Jones), C. W. Trigg (2), Robert Cummings, Walter L. Steinfatt (3, 4, 5), and H. F. Finch. Also acknowledged are solutions of the rabbitry triangles by F. G. Switzer, C. W. Trigg, and Fred W. Morrill.]

Contracts for Alaskan Projects Are Awarded

Award of several contracts for construction of Alaskan projects is announced by the Alaska District of the Corps of Engineers. S. Patti Construction and MacDonald Construction companies of Kansas City, Mo., have been given a contract covering construction of 46 eight-family quarters for Ft. Richardson. Their bid was $5,620,703. Peter Kiewit Sons' Company, of Omaha, Nebr., has received a $1,236,096 low-bid contract for construction of two 200-man barracks for Ladd Air Force Base. Another contract goes to McInroy Drilling and C. R. Lewis companies, joint-venturers with a bid of $122,376 for construction of deep wells at Elmendorf Air Force Base. The Elmendorf Base will also have a 400-bed hospital, to be built by J. C. Boespflug, Seattle, with a $8,364,970 low-bid contract.

American and Canadian contractors are invited to bid on Alaska defense construction projects. Programs are now being scheduled for bid openings on 264 projects in 1953 and 1954. With jobs valued from several thousand to several million dollars, there are many opportunities for small as well as large contractors.

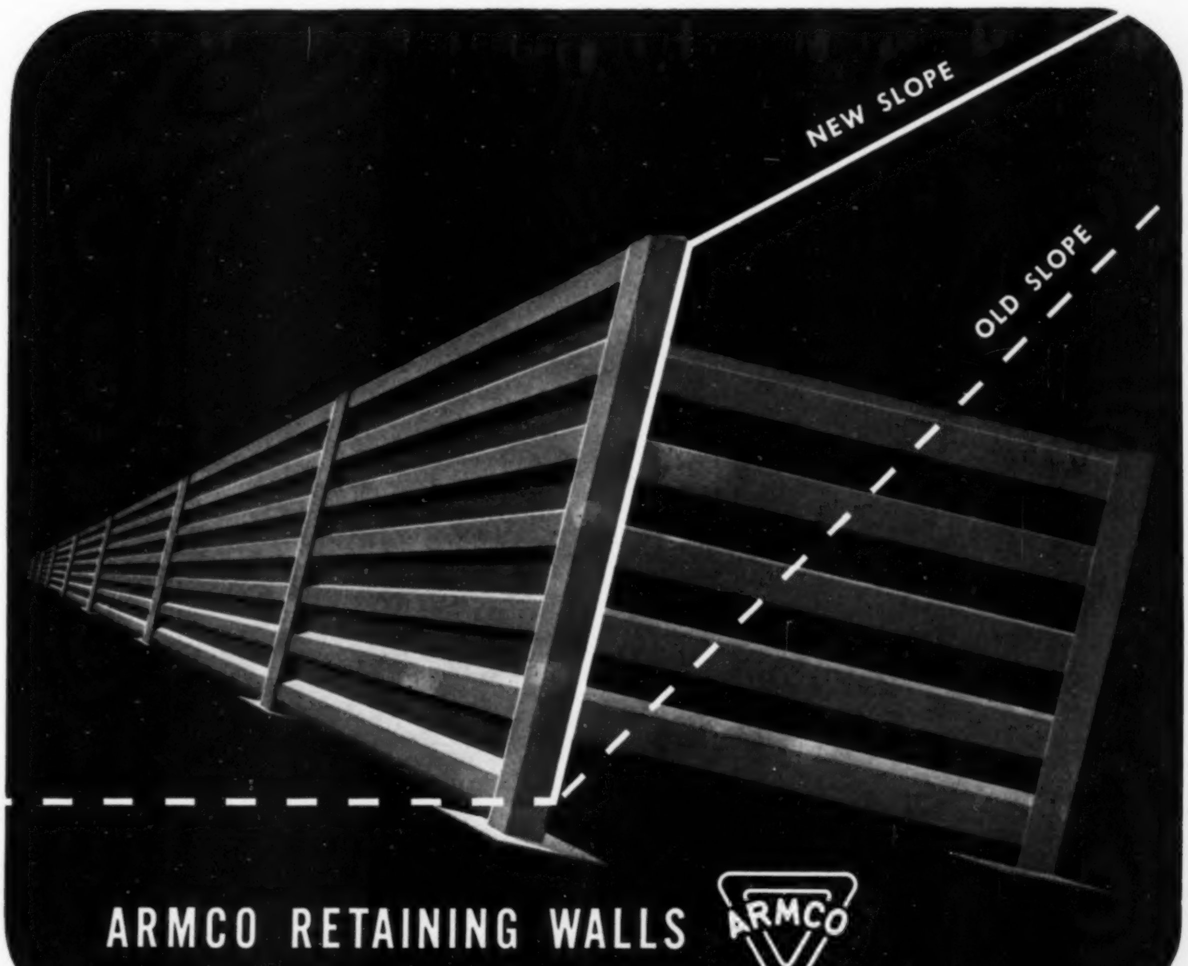
A new slant on the "angle of repose"

When unstable slopes seek their "angle of repose" they often cause a lot of trouble. Engineers used to solve such problems with heavy massive retaining walls. Then Armco engineers had a new slant. They said: "Why not make earth itself do most of the work?" The result—Armco Bin Type Retaining Wall.

The advantages of this flexible metal wall are obvious. Less material need be transported to the job site. Handling is easier and less excavation is required. Individual units are nestable for shipment and storage.

Unskilled men do the work quickly using only hand tools. Armco Walls are adaptable to curves and changes in elevation; can be extended or completely salvaged. They withstand temperature changes and the destructive effects of ice and snow. Expansion and contraction are safely absorbed by the unique all-metal construction. There is no danger of cracking.

Thousands of installations prove Armco Retaining Walls ideal for unstable slopes, right-of-ways, stream erosion and similar uses. Write for complete data on your specific needs. Armco Drainage & Metal Products, Inc., 2173 Curtis Street, Middletown, Ohio. Subsidiary of Armco Steel Corporation. Export: The Armco International Corporation.



DECEASED

George Norris Adams (A.M. '18), age 73, Los Angeles civil and hydraulic engineer practicing in Southern California for the past 40 years, died in Glendale on December 17. He was associated with the FitzGerald Engineering & Construction Co., for 25 years and more recently had been with the L. S. Whaley Co.

Willard Aron Anderson (A.M. '32), age 52, plant engineer for the U.S. Government Printing Office, Washington, D.C., died on November 28. A graduate of the Armour Institute of Technology, Mr. Anderson had been in the Government Printing Office since 1930.

Gustaf Birger Andreen (A.M. '17), age 73, structural engineer of Elmhurst, N.Y., died on December 23. A graduate of the Royal Technical College, Stockholm, Sweden, Mr. Andreen had been connected with many projects including the proposed Tappan Zee Bridge and the N.Y. State Thruway. During World War II, he served on the staff of the late Rear Admiral Frederic Harris.

George Morgan Bacon (M. '05), age 80, former Utah state engineer (1925–1933), died on December 17, in Alexandria, Va. In retirement since 1933, Mr. Bacon maintained a private practice intermittently from 1898 to 1925, in Salt Lake City. He was a graduate of Cornell University.

Frederick Andrew Baker (A.M. '17), age 68, retired engineer of New York City, and graduate of Cooper Union, died on December 10. A specialist in the design of pulp and paper mills, Mr. Baker had been associated for several years with Frederick L. Smith, and Roderick O'Donoghue, consulting engineers of New York.

Charles Hampton Burks (M. '51), age 46, died at his home in Jacksonville, Fla., on December 21. A graduate of the Georgia Institute of Technology, Mr. Burks was employed in various capacities by the Seaboard Air Line Railroad from 1936 until 1951, when he joined Merritt-Chapman & Scott as engineer.

Robert Mavin Cooksey (M. '17), age 71, since 1923 city manager of Thomasville, N.C., died in that city on December 27. Earlier Mr. Cooksey was with the Baltimore city engineering department and he served in World War I as a major in the Army. Mr. Cooksey was former vice-president of the International City Managers' Association.

Ralph Stephenson Corlew (M. '45), age 67, division maintenance engineer with the U.S. Bureau of Public Roads, died on September 26, while on a business trip at Grand Lake, Colo. A member of the Bureau working out of the Denver office since 1919, Mr. Corlew was highway and senior highway engineer for many years.

Oliver Hamline Dickerson (M. '15), age 88, retired engineer of St. Paul, Minn., and a graduate of Franklin College and the Case School of Applied Science, died in July 1952. Following 21 years of service (1908–1929) with the Duluth & Iron Range Railroad at Duluth, he worked for the Minnesota State Highway Department, the Duluth Water and Light Department, and other agencies.

Raymond Emile Gauthier (A.M. '45), age 43, since 1941 district engineer for the Bethlehem Pacific Coast Steel Corp., at Alameda, Calif., with which he had been connected for 17 years, died in San Francisco, on December 20. He was an alumnus of the University of California.

Bernard Henry Grehan (M. '30), age 59, associated with the Boh Bros. Construction Co., of New Orleans, La., since 1948, died in December. For many years previously Mr. Grehan was vice-president of the Geo. J. Glover Company, Inc. A graduate of Tulane University, he served as president of the Louisiana Section of ASCE in 1928 and 1929.

Walter Hoffmann (M. '50), age 65, in charge of structural design for Albert Kahn Associated Architects & Engineers, Inc., Detroit, Mich., died on December 20. Prior to 1940, Mr. Hoffmann was associated with the Viennese firm of Baugesellschaft H. Rella & Co. for 25 years. He was a graduate of the Institute of Technology in Vienna.

Samuel Koffsky (M. '42), age 50, chief engineer of the Simmons Machine Tool Corp., and general manager of the related Simmons Fastener Corp., died at his home in Albany, N.Y., on January 15. Mr. Koffsky, a graduate of Rensselaer Polytechnic Institute, had been affiliated with the firms for the past 16 years.

Emery Alphonse La Vallée (A.M. '39), age 70, landscape engineer of San Francisco, Calif., died on November 29. Employed by the Pacific Islands Engineers at the time of his death, Mr. La Vallée had been engaged in private practice at various times during his career and connected with Army, Navy, hospital, housing and hotel projects on the West Coast.

Spencer William Lowden (A.M. '18), age 64, associated with the California Division of Highways since 1912 when he began as a rodman, died on January 13. Promoted to district engineer in 1925, he served at Redding, San Luis Obispo, Bishop, and (since 1950) San Bernardino.

John Crane McVea (M. '20), age 76, consulting engineer of Houston, Tex., and a graduate of the University of Texas, died on December 16. Engaged in the municipal service of Houston from 1913 to 1929, Mr. McVea was city engineer for ten years. For most of the period since 1929, he had been in private practice.

John Laroy Mann (M. '11), age 80, since 1944 designing engineer for the Indiana State Highway Commission at Indianapolis, died on December 11. Mr. Mann taught at the Thayer School of Engineering, his alma mater, for five years, and at various periods was connected with the U.S. Reclamation Service, the Monte Christi Irrigation Service, the City of New York and the Indiana Limestone Co.

Charles Edward Maxfield (A.M. '24), age 73, in private practice as a structural engineer in Cleveland, Ohio, from 1923 to 1950, died on July 2. At the time of his death he held the position of senior assistant civil engineer for the City of Cleveland Division of Engineering and Construction.

Franz Martin Misch (A.M. '40), age 45, general bridge and building supervisor with the Southern Pacific Co., died at Dos Palos, Calif., on December 1. His association with the company began in 1929, shortly after graduation from the University of California.

Colone Will Jackson Neville (M. '12), age 72, retired engineer of New Orleans, La., and commander, USNR (retired), died during the fall of 1952. Mr. Neville was president and chief engineer of the General Engineering Co., New Orleans, from 1920 until his retirement in 1944. He held both the bachelor's and master's degrees in civil engineering from Cornell University.

Eric Colburn Norton (A.M. '39), age 47, principal civil engineer with the New York State Department of Public Works, at Albany, N.Y., died on October 21. After graduating from Rensselaer Polytechnic Institute in 1926, Mr. Norton taught civil engineering there for a year. He then entered the Highway Department, which he had served without interruption since 1928.

George Spencer Pierson (M. '89), age 97, retired consulting engineer of Kalamazoo, Mich., and one of the oldest members of ASCE in point of affiliation, died on December 30, 1951. He was an alumnus of Union College. In general practice since 1890, Mr. Pierson specialized in hydraulics and municipal sanitation problems, serving almost 100 different cities.

William Allen Poe (A.M. '30), age 69, assistant construction engineer with the Arkansas State Highway Commission at Little Rock, died on September 25. On the staff of the Highway Commission for more than twenty years, Mr. Poe held the positions of highway and senior highway engineer at various times.

Harold Alva Rands (M. '25), age 81, former senior hydroelectric engineer with the U.S. Corps of Engineers at Portland, Oreg., retired since September 1943, died on January 8, 1952. A graduate of Cornell University, Mr. Rands had been in private practice in Portland, for several years and was connected with many Pacific Coast power and irrigation projects.

Rasmus Rasmussen (M. '37), age 69, of San Francisco, Calif., died on January 21. Mr. Rasmussen had been engineering consultant to the Bates & Rogers Construction Corp., since his retirement in 1951 from active participation in the firm after 43 years of service. He had been district manager and chief engineer for the company and had worked in its Chicago and San Francisco offices. He was an alumnus of Michigan State College.

St. George Tucker Richardson (M. '47), age 70, consulting engineer of Memphis, Tenn., died on October 18. Maintaining a

private practice in Memphis since 1905, Mr. Richardson also served as county surveyor of Shelby County, Tenn., from 1905 to 1927, and county engineer from 1906 to 1915. He attended the University of Tennessee.

Robert Lawrence Rolfe (A.M. '16), age 63, for many years consulting and structural engineer of Dallas, Tex., died at his home in that city on December 9. Earlier in his career he was connected with Gardner & Howe, and the U.S. Engineer Office at Memphis, for more than ten years. Mr. Rolfe had studied at the University of Colorado.

Edward Josef Romanski (M. '51), age 66, specialist engineer for the Argentinian Society of Designing Engineers, Mendoza, Argentina, died there on November 24. An authority on irrigation and hydraulics, Mr. Romanski had taught at several technical colleges in Moscow and Warsaw and at the American University in Beirut. He was a graduate of the Politechnical Institute of Peter the Great.

Fremont Emerson Roper (A.M. '25), age 63, assistant chief engineer, Marketing Department, Standard Oil Co., of Calif., at San Francisco, died in May 1952. Continuously connected with Standard Oil since 1912, he had been superintendent of construction and assistant manager of the sales construction and maintenance department for more than 20 years. Mr. Roper was a graduate of Brown University.

Charles Adrian Sawyer, Jr. (M. '20), age 76, president of the Sawyer Construction Co., of Boston, Mass., for 27 years, died in January 1952. Previously Mr. Sawyer was connected with Howes Bros., of Boston for seven years, and with the George A. Fuller Co., for ten years. He was an alumnus of the Massachusetts Institute of Technology.

Emil Schaeffer (M. '47), age 64, chief engineer with the Elizabeth Iron Works, Elizabeth, N.J., and one-time chief engineer and member of the executive board of the Krupp Works in Berlin, died on November 17. Since arriving in the United States in 1941, Mr. Schaeffer had engaged in private practice and served as engineer of the Harco Steel Construction Co., Inc., Elizabeth. He graduated from the Technical University of Vienna.

James Elmo Smith (M. '22), age 75, three-time mayor of Urbana, Ill. (1919–1924), died recently. Mr. Smith, a graduate of the University of Wisconsin, taught at the University of Illinois for 15 years, engaged in private practice for several years, and from 1935 until his retirement in 1948 served as assistant superintendent of buildings at the University of Illinois.

Stephen Riggs Truesdell (A.M. '20), age 64, special assistant, President's Office, Chicago and Northwestern Railway, died on August 16. An authority on transportation engineering, Mr. Truesdell, had worked for several railroad and bus companies, and on military railways during World War II, holding the rank of major in the Army. He was with the C. & N. a total of 22 years.

Oscar Flynn Sewell (A.M. '47), age 56, since 1923 county engineer and surveyor for Pawnee County, Okla., and city engineer of Pawnee, was killed in an automobile accident on November 22. In private practice also since 1923, Mr. Sewell was a partner in the Sewell Engineering Co., with headquarters in Pawnee and Duncan, Okla.

John Davidson Spinks (M. '21), age 69, consulting engineer practicing in Winston-Salem, N.C., since 1919, died on November 22. For twelve years, he also served as county engineer at Albemarle. Mr. Spinks was an alumnus of North Carolina State College.

Roderick William Tipton (J.M. '48), age 27, sales engineer for the American Bitumuls Co., Maplewood, Mo., died on June 19. A graduate of Ohio State University, Mr. Tipton had also worked for the U.S. Geological Survey for a brief period.

Augustus Miesse Turner (A.M. '08), age 75, president of A. M. Turner Co., of Chicago, Ill., died in Evanston on November 15. Previously Mr. Turner had been general manager of the M. E. White Co., and vice-president of the Paquette Engineering Corp., both of Chicago.

James Tyler (A.M. '19), age 75, retired engineer of Auckland, N.Z., died during the late winter of 1952. For many years, until his retirement in 1944, Mr. Tyler was city engineer of Auckland. He studied at the University of Auckland.

Romney Leigh Vaughn (M. '31), age 66, retired consulting engineer of San Francisco, Calif., and graduate of Leland Stanford University, died on December 15. A specialist in dredging and harbor and bridge construction, Mr. Vaughn maintained a private practice in San Francisco for many years.

Gerrit Waalkes (A.M. '15), age 66, president of the Anchor Steel & Conveyor Co., Detroit, Mich., since its establishment in 1926, died on August 25. For several years Mr. Waalkes was also secretary and treasurer of Summer & Waalkes, Inc. Earlier he was employed by the Mt. Vernon Bridge Co., and the Ford Motor Co. He was an alumnus of the University of Michigan, class of 1908.

Jerome Frederick Wilhelm (A.M. '06), age 78, retired engineer of Traverse City, Mich., died on November 26, after a long illness. From 1906 until he retired in 1928, Mr. Wilhelm held responsible positions on bridge foundation and pneumatic pier construction jobs. He was an alumnus of the University of Pennsylvania.

Horace Meldrum Woolley, Jr. (A.M. '20), age 61, who had served continuously as manager of the Construction Device Co., at Cleveland, Ohio, and San Francisco, Calif., since 1927, died on February 26, 1952.

Raymond Cliff Yant (A.M. '21), age 69, president of the Yant Construction Co., Omaha, Nebr., died on June 22. Mr. Yant had engaged in general contracting for more than 30 years. He was an alumnus of the University of Illinois, class of 1907.

NEWS OF ENGINEERS

William Goldsmith (left), president of Woodcrest Construction Co., New York City, receives special citation as "Cooper Union Alumnus of the Year" from Jack Gould, president of Cooper Union Alumni Association, at Annual Founder's Day Dinner of the Association at the Waldorf-Astoria in New York, February 14. Mr. Goldsmith is prominently identified with metropolitan construction projects and former Commissioner of Public Works for City of Yonkers.

C. Glenn Cappel, former ASCE Director for District 15 and partner in the W. Horace Williams Co., of New Orleans, was recently awarded the Louisiana Engineering Society's Technological Accomplishment Medal for the year 1952. The presentation was made January 8, during the society's annual meeting in New Orleans.

Paul W. Abeles, consulting engineer and lecturer on prestressed concrete at the Brixton School of Building, London, recently completed a series of lectures in this country. Dr. Abeles, who was guest lecturer at such schools as M.I.T., Lehigh University, California Institute of Technology, and the Universities of California, Illinois, and Michigan, also presented a paper on "Prestressed Concrete Design and Construction Practices in England," at the Western Conference on Prestressed Concrete.

Charles M. Gard, formerly sanitary engineer for Alden E. Stilson & Associates, Columbus, Ohio, is now an associate engineer with the firm.

George E. Goodall and **Jack S. Barrish,** consulting civil and structural engineers, announce the new location of the offices of the George E. Goodall Co., at 801 Ninth Street, Sacramento, Calif.

Clay P. Bedford, president and director of the Chase Aircraft Company, Inc., since last May when he left Washington after serving as special assistant to C. E. Wilson, former Director of Defense Mobilization,

WESTERN *licks "Chicago Clay"*

DRIVES SECURE FOUNDATIONS FOR VETERANS ADMINISTRATION BUILDING

A steel drive-tube of sufficient length with close-fitting steel core, is driven into the ground. The core is removed and the closed end pipe section is driven out of the tube using the core as a follower. Foreign matter is excluded from the drive-tube by a gasket attached to the upper end of the pipe. When the driving of the pipe has been completed a corrugated shell is screwed down over the dogs (or anchors). These anchors are welded onto the pipe and develop a strong mechanical bond between the two sections. When required by site conditions, an alternate water-tight slip-joint is used. Both sections are then filled with concrete.

The subsoil at the site of the Regional Office and Clinic Building of the Veterans Administration in Chicago, is "Chicago Clay" at its worst. In view of previous foundation difficulties in this area, piling specifications placed full responsibility on the foundation contractor, while allowing a wide choice as to pile type and procedure. Western's Projectile pile was selected.

It was necessary to obtain approval of the type and method of installation. In accordance with the specifications, two groups of seven Projectile type piles each were driven and one pile in each group was subjected to an 80-ton load test. Measurement of tested piles showed less than 0.3 inch settlement under 80 tons. Specifications permitted 0.6 inch. This testing operation required 12 days.

Upon approval from the Veterans Administration, driving of the contract piling was started. Installation of 1380 piles was completed in 45 working days.

As the job progressed, five additional load tests to 80 tons each were conducted on piles selected by the Veterans Administration Resident Engineer. All were similar in behavior, with a net settlement of less than one-half of the allowable. No measurable horizontal movement of individual piles or groups of piles was detected. Although all piles were redriven, as required by the Specifications, practically no movement occurred, indicating that the slight heave which had been observed in the lower section, was due to compaction of the hardpan under the bottom of the pile.

Consultation is invited. Write for our catalog.

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WESTERN FOUNDATION CORPORATION

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has been elected a trustee of Rensselaer Polytechnic Institute. Mr. Bedford also holds the vice-presidency of Henry J. Kaiser Co., and several Kaiser subsidiaries.

John S. Bethel, Jr., for several years a member of the staff of Metcalf & Eddy, Boston, Mass., was admitted to partnership in the firm on January 1, 1953.

Benjamin Everett Beavin, Sr., has been admitted to partnership in Porter-Urquhart Associated and O. J. Porter & Company. All offices of the firm are now conducted in the name of Porter, Urquhart & Beavin.

George H. Herrold, city planning consultant for St. Paul, Minn., is retiring after 33 years in the field of city planning. In the St. Paul municipal service since 1912, Mr. Herrold was director of city planning from 1930 to 1952. He participated actively in planning and designing such major St. Paul improvements as Kellogg Boulevard, the location of the Robert St. Bridge, and the Capitol Approach program.

George H. Herrold

Boyce Engineering Associates, civil engineering firm of Wallingford, Conn., has opened a second office in Meriden, Conn., at 69 East Main Street. **Russell I. Boyce,** chief engineer of the firm, is currently serving as borough engineer for Wallingford.

Odell B. Bradshaw, assistant city engineer of Lima, Ohio, for the past six years, was recently named service-safety director of Maumee, Ohio. Mr. Bradshaw will be in charge of the street, sewer, water, police and fire departments.

Harlen J. Campbell has resigned as project engineer for the New Mexico Highway Department at Nara Vista to become construction engineer for the Home Improvement Co., of Albuquerque.

John Clarkeson announces the expansion of his organization for the practice of civil engineering under the new name of the Clarkeson Engineering Company, Inc., with offices at 285 Columbus Avenue, Boston, Mass.

Charles D. Curran has returned to his permanent position as senior specialist on engineering and public works in the legislative reference service of the Library of Congress after completion of an assignment as staff director for the House of Representatives' subcommittee to study civil works.

R. L. Sloane, associate professor of civil engineering at the University of Utah, has participated in the formation of a firm of consulting engineers, R. L. Sloane Associates, 140 West Second Street, Salt Lake City, Utah. The newly-created organization will specialize in soil mechanics and foundation engineering.

(Continued on page 92)

HIGHWAYS?

AERO SERVICE mapped a mile-wide route strip for the 140 mile Pennsylvania Turnpike Extension in one-fifth the time and one-fifth the cost of ground survey methods. Turnpike engineers praised the complete, accurate detail of AERO maps. This survey is part of AERO's more than 1,000 miles of highway mapping experience.

CITY MAPPING?

Durham, N. C., urgently needed new city maps to solve problems of expanded industry and population. AERO delivered them in one-tenth the time and one-sixth the cost of ground survey methods, giving city engineers all facts needed for proper planning.

INDUSTRIAL DEVELOPMENT?

In one of the biggest, fastest mapping jobs ever done, AERO rushed accurate detail of the 210,000 acre Savannah River Atomic Energy facility: The first 1,000 acres in 15 days, and 6,000 acres a week thereafter. Construction schedules were moved ahead by months.

Whether your project be for city, highway or industry . . . pipe or power line locations . . . railroad right-of-way . . . flood control . . . petroleum or mining development, or any one of a host of others, AERO methods can speed your mapping at low cost and high accuracy. Our experience—34 years of it—is worldwide. Let our engineers meet with you.

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(Continued from page 90)

Alfred O. Quinn, chief, engineering and field surveys, with the Aero Service Corp., Philadelphia, was elected president of the American Society of Photogrammetry on January 15. A member of the society since 1936, he served as chairman of several committees, as director, and most recently as vice-president. During World War II, Mr. Quinn served as an officer in the Navy in the Pacific theater. Mr. Quinn taught at Syracuse University from 1946 to 1950.

Alfred O. Quinn

Robert M. Belt retired recently after serving for five years as superintendent of public works for the Territory of Hawaii, and chairman of the Board of Harbor Commissioners. As president of the Hawaii Section, Mr. Belt is chairman of the post-convention tour to Hawaii scheduled to follow the ASCE San Francisco Convention.

Bruce A. Lamberton has been promoted from field engineer to regional manager for the Prepakt Concrete Co., and Intrusion-Prepakt, Inc., for Colorado and adjacent states. His office address is now 308 C.A. Johnson Building, Denver, Colo.

Sigmund L. Levin, formerly with the Los Angeles County Flood Control District and associate editor of "The Engineer" has opened an office for the practice of civil engineering at 12198½ Ventura Blvd., Room 105, Studio City, Calif.

Milton Male, since 1946 director of housing research in the research and technology of the United States Steel Corp., at Pittsburgh, Pa., was recently appointed manager of the building and construction industries section of U.S. Steel's commercial department.

Glenwood Lyle McLane, district engineer for the U.S. Bureau of Public Roads at Phoenix, Ariz., and a past-president of the Arizona Section of ASCE, retired on January 31. Mr. McLane has been with the Bureau of Public Roads since 1919, and district engineer at Phoenix since 1929.

Edward J. Quirin, president of the New York City consulting engineering firm of Frederic R. Harris, Inc., announces that the New York firm of Baker & Spencer, Inc., has affiliated with his firm. Mr. Quirin will be president of both firms, and **C. G. Spencer,** one of the founders of Baker & Spencer, Inc., will continue as a consultant with the group as a vice-president of Baker & Spencer, Inc.

Robert Torp-Smith, until recently with the Civil Engineer Corps of the U.S. Navy as Planning and Sea Bee Organizations Officer in the Pacific Area, will head the newly established Soil Testing Services of Michigan, with offices and laboratory in Portland, Mich. The firm, an affiliate of Soil Testing Services, Inc., of Chicago, will

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SAN FRANCISCO CONVENTION—MARCH, 1953

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specialize in soil mechanics and foundation problems and subsurface explorations in the Michigan area.

Burnside R. Value of the engineering firm of Seelye, Stevenson, Value & Knecht, of New York City, has been elected president of the New York Association of Consulting Engineers.

S. S. Steinberg, dean of the University of Maryland College of Engineering, has been named adviser to the School of Engineering of the University of Puerto Rico at Mayaguez. He is currently visiting the island to confer with university administrative officers and faculty members on the development of their engineering curricula and laboratory facilities.

Francis W. Daniels, associated with the H. K. Ferguson Company for more than 28 years, has been appointed vice-president in charge of engineering. Prior to that he served as manager of the Cleveland District for five years.

George S. Salter, named chief filtration engineer in the newly reorganized Chicago Department of Public Works (see page 81), has been elected president of the Chicago Engineers' Club.

H. W. Van Loo has been appointed construction engineer-in-charge on the Coachella division of the All-American Canal System, a Bureau of Reclamation project, after acting in the position since August.

Clyde E. Williams & Associates of Indianapolis, Ind., announce the affiliation of three Indianapolis men: **August W. Compton,** formerly district airport engineer, Civil Aeronautics Administration; **Thomas J. Driscoll,** formerly office engineer, Portland Cement Association; and **William E. Koch,** formerly sales engineer, Armco Drainage and Metal Products Co.

W. J. Strout of Houlton, Me., chief engineer of the Bangor and Aroostook Railroad, and acting mechanical superintendent, has been named mechanical superintendent for the railroad. He continues to serve as chief engineer.

George A. Quinlan is resigning as superintendent of the Cook County Highway Department after many years of service. During his tenure he directed the expansion of the highway system in the county from one mile of concrete to 2,000 miles of paved roads.

Change of assignments of personnel in the Upper Mississippi Valley Division Office of the Corps of Engineers has resulted in promotions for the following: **A. F. Griffin,** for many years principal civilian engineer in the Office of the Division Engineer, has been assigned as chief engineering consultant for the entire Division; **L. B. Feagin,** formerly principal civilian engineer in the St. Louis District Office has been transferred to the Office of the Division Engineer, as chief of the Operations Division; and **C. F. MacNish,** who served as chief of operations and assistant chief of the Engineering Division, continues in the latter capacity with the additional duties of chief of the Design Branch.

Leo J. Foster, design and construction division consulting engineer with the U.S. Bureau of Reclamation at Denver, Colo., retired on January 31 after establishing the longest service record ever compiled by a Reclamation Bureau employee—48½ years. Since 1944 Mr. Foster has been on the chief engineer's staff, reviewing and analyzing plans for proposed reclamation projects.


Leo J. Foster

Irving Quinn announces the formation of the firm of Leichtman & Quinn, consulting engineers, at 20 Vesey Street, New York, N.Y. Previously Mr. Quinn was chief engineer for the Design Service Co., of New York City.

Nelson H. Rector, a veteran of 31 years' service in malaria control work in the southeastern United States, has retired from the U.S. Public Health Service, and will continue to make his home in Atlanta, Ga. Since 1942, Mr. Rector has been with the Communicable Disease Center.

Hale Sutherland is retiring as professor of civil engineering at Lehigh University with the rank of professor emeritus of civil engineering, after 23 years as a member of the faculty. Previously he taught at the Massachusetts Institute of Technology for 17 years. Professor Sutherland is co-author of two textbooks on structural design.

Bengt F. Friberg, civil engineer, has entered practice as a consulting engineer, with offices at 915 Olive Street, St. Louis, Mo. He will specialize in steel and concrete structures, pavement design, prestressed concrete and product consultation to the construction industry. Since the war, Mr. Friberg has been connected with the Granite City Steel Co., Granite City, Ill., most recently as vice-president and general manager for its subsidiary, Granco Steel Products Co.

Sam S. Williams, lieutenant colonel, Corps of Engineers, assumed command of the 79th Engineer Construction Battalion, now in Korea, after graduating from the Command General Staff College. Colonel Williams reports that the battalion is actively engaged in the rehabilitation of war damaged buildings and the construction of new buildings.

Francis G. Wrightson, assistant to the general manager of the Bethlehem Steel Co., and the management's representative at the Sparrows Point plant, recently retired after 34 years of service with the company. He has served as division engineer, superintendent of the plate finishing mills, assistant to the general manager and, since 1920, industrial relations head.

Edward R. Stapley, dean of the Oklahoma Institute of Technology of the Oklahoma Agricultural and Mechanical College, was recently awarded an honorary membership in the Engineers Club of Tulsa and also named "Engineer of the Month."

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Men Available

Civil Engineer; M. ASCE; 39; graduate; registered. Experienced manager of major construction, plant maintenance and utilities operation programs. Capable personnel supervisor. Desires responsible position with contractor, industrial firm or consultant. C-815.

Structural Engineer; A. M. ASCE; 30; married; B.S. in architectural engineering; with over 4 years' experience with consulting professional engineers and architects; 1 year field engineer on construction; some land subdividing and allied works; registration applied for. Desires position with architectural and/or engineering firm in Houston. Will consider relocating South or Southwest. C-816-554-Chicago.

Estimator and Foreman; J. M. ASCE; 27; B.S. in C.E., 1950. 2½ years' experience estimating and supervising brick mason work of all sizes (house work, banks, schools). Journeyman union bricklayer. Desires position with large contractor. Any location. C-817.

Construction Engineer; A. M. ASCE; P.E. license Texas and New York; university graduate; experience in water works, housing developments, general construction, also operation and maintenance; desires to relocate in southeastern Texas. C-818.

Construction Engineer; A. M. ASCE; 27; married; graduate; six years' progressive experience in foundations and commercial building construction; speaks Spanish; desires challenging position with consulting firm operating in southwestern United States or Latin America. Available June 1. C-819.

Assistant Professor; A. M. ASCE; 42; married; B.S. in C.E.; B.S. in E.E., M.A.; registered; 18 years' varied experience in civil engineering work and teaching. Available September. C-820-521-A-1-San Francisco.

Party Chief or Surveyor; J. M. ASCE; 24; married; 2 years with highway dept.; 8 months on airfield construction; 5 months on heavy building construction. C-821-532-A-1-San Francisco.

Civil Engineer; J. M. ASCE; 30; single; B.C.E., 1950; 2 years' experience in highway planning, site development and installations engineering (Air Force); construction supervision, inspection and management. Desires position with company of diversified operations. Prefer temporary location in U. S. C-822.

Positions Available

Hydraulic Engineer thoroughly acquainted with leakage surveys on water distribution systems, including the use of Pitometer equipment, sounding instruments and other equipment utilized in this very specialized field. Location, Florida. Y-7716.

Staff Engineer, construction, 30-45, with civil engineering degree preferred, and up to 10 years' experience in similar work described below. Will act as office engineer and resident engineer on industrial plant changes and expansion, large and small projects. Broad experience required on building construction. Knowledge of equipment erection desirable. Able to review structural designs and suggest improvements, make cost estimates, review proposals and advise on letting contracts. Act as company representative on projects away from home office. Travel required. Salary, $5,400-$6,800 a year. Location, New Jersey. Y-7820. Reopened.

Engineers. (a) Civil Engineer experienced in design of airport pavements, drainage and substructures, etc., who must also be familiar with civil work site planning for building structures. Should be good draftsman capable of reproducing his own designs in addition to supervising others. (b) Civil Engineering Draftsman adept in preparation of ink or pencil drawings of civil work structures including pavements, drainage and substructures, and who can plot topography from surveyor's notes. Location, Virginia. Y-7884.

Structural Engineer, 33-39, with 5 to 10 years' broad experience in design and construction in both the structural steel and concrete fields. Should have a degree in civil or architectural engineering. Experience should be preferably in the engineering department of a petroleum refining or chemical company of a contracting

firm constructing such facilities. Location, Maryland. Y-7991.

MATERIALS ENGINEERS. (*a*) Chief for general supervision on materials specifications and mixes for asphalt and concrete pavements. (*b*) Field Men to check work of materials and pavement inspectors. Location, eastern states. Y-8044.

PROJECT MANAGER, 35–40, civil graduate, with at least 5 years' construction supervisory experience covering industrial buildings and heavy construction, to plan projects, schedule work and be responsible for performance of superintendents on various projects. Salary, $7,500–$8,500 a year. Location, Maryland. Y-8064.

CIVIL ENGINEER OR ARCHITECT, 30–35, graduate, with at least 5 years' office building or institutional experience covering design, specification, cost and construction experience, to act as resident engineer on theater chain construction and alteration work. Considerable traveling in U.S.A. Salary, $6,000–$7,000 a year. Headquarters, New York, N.Y. Y-8096.

MANAGER OF WATER WORKS AND SEWER DEPARTMENT, preferably civil engineer with water works and sewer design experience, plus managerial ability. Salary, $6,000 a year. Location, Tennessee. Y-8098.

SALES ASSISTANT, 25–30, with office and correspondence experience in heavy construction field to attend to filing, sales correspondence and assist in preparation of specifications, quotations covering concrete construction. Salary, $5,200 a year. Location, New York, N.Y. Y-8132.

INSTRUCTOR to teach undergraduate structures courses. Excellent opportunity to do graduate work in applied mechanics up through doctoral degree. Will consider 1953 graduate. Position starts summer or fall of 1953. Salary open. Location, New York, N.Y. Y-8134.

SENIOR CONSTRUCTION ENGINEER with degree in civil, architectural or construction engineering with 6 to 10 years' experience in the engineering field. Will render general assistance, supervising office and field work involving the construction of buildings, airports, sewers, industrial installations and houses; supervising contract work, preparing engineering specifications, drawings and cost estimates for new work and requisitioning materials for contractors on the job and maintaining flow of materials to construction sites. Must go single status for 6 months to a year. Salary, about $11,000 a year. Location, Venezuela, South America. Y-8154.

INSTRUCTORS, young, B.S. degree in C.E., excellent opportunity for part time research in highway engineering. Opportunity to pursue graduate work. Must be U.S. citizens. Salaries open. Location, West. Y-8156.

CIVIL ENGINEERING DEPARTMENT HEAD, preferably with Ph.D. degree. Salary open. Location, New England. Y-8187-(*a*).

TOWN ENGINEER, civil graduate, with municipal engineering experience covering buildings, water supply, highway and street mapping. Salary, $5,000–$6,000 a year. Location, New Jersey. Y-8205.

FIELD ENGINEER, 26–35, civil graduate, with bituminous paving experience, for sales and construction supervision of rubberized bituminous pavements, covering special work on roads and airports. Some traveling. Salary, $5,000–$6,000 a year. Headquarters, New York Metropolitan area. Y-8215.

CIVIL ENGINEER, 35–45, with construction experience covering railroad highway, bridge, drainage, etc., for sugar mill plantation. Must speak Spanish. Salary open. Location, Caribbean area. Y-8220.

RESIDENT ENGINEER, civil graduate, with at least 10 years' highway and bridge construction experience. Must have New York State P.E. license. Location, upstate New York. Y-8225.

RESIDENT ENGINEER, 27–32, graduate in C.E. or building construction engineering preferred, with at least 2 years of active work in the construction field, preferably on industrial plants. Salary open. Location, upstate New York, Y-8226.

SALES ENGINEER, 24–40, civil graduate, with some sales experience, for large manufacturing concern in construction materials. Prefer residents of Florida. Y-8230.

MARINE CONSTRUCTION SUPERINTENDENT, civil engineer, 35–40, with at least 5 years' experience in heavy construction, such as bridge foundations, breakwaters, piers and docks. Will be in charge of projects; supervise marine construction work and dredging. Salary, $6,500–$7,500 a year. Employer will pay fee. Location, Chicago. R-9597.

INSTRUCTORS, mechanical or civil engineers. Good scholastic records. To teach engineering drawing and descriptive geometry. Postions start September 1953. Could use one man now. Salary, to $4,000 for nine months. Location, Illinois. T-9523.

Big equipment on Boqueron tunnels

This article begins on page 38

(*Continued from page 40*)

necting piping, were the other items constructed inside the tunnels. A $^3/_4$-cu yd backhoe was used to excavate the ditch, which had been previously drilled with wagon drills, and shot ahead of concrete work for the footing.

Concrete aggregate was made in a Lippman 24-in. by 36-in. primary crusher, and a 42-in. Roll secondary crusher. This aggregate was purchased from two local sites and stockpiled on the job site after crushing. Both washed river sand and sea sand were used.

The batching plant was a Noble, with 4-compartment bins, and a 350-ton capacity. The bins were filled by a conveyor from a tunnel under the sand and stone stockpiles.

Cement and water were measured by an electric eye, while sand and stone were manually controlled. All quantities were controlled by a batch plant ticket system, whereby the government inspectors received a carbon copy of the quantities included in each batch.

The shops built on the site included a machine shop capable of making all repairs to equipment, and an electric shop, where all electrical repairs and prefabricating of embedded electrical items were done. A drill-sharpening shop to keep the drill steel in shape, and a welding shop completed the shop facilities. A first-aid building maintained by the local Social Security Agency and the company, is equipped to provide immediate medical service.

Two warehouses provided storage for heavy items. The one at the tunnel site stocked all spare parts and job service items. The other, on the main highway about 2 miles from the tunnels, was also the site of the reinforcing fabricating yard, as all steel bending was done at the site.

There was also a job office to house the administration, engineering, accounting and industrial relations departments, as well as the payroll and timekeeping departments.

The job was under the direction of C. D. Graham, Vice President and Project Manager. The Administrative Manager was Fred B. Craddock, and the Chief Engineer, E. Donald Phinney, M. ASCE. The Office Engineer was Dick Jackson, J.M. ASCE, and the Cost Engineer, Ray Baker. The entire project came under the supervision of M. G. Kennedy, President of South American Operations, located in the New York offices of the company.

Non-ASCE Meetings

American Congress on Surveying and Mapping. Map uses will feature the 13th annual meeting of the American Congress on Surveying and Mapping, to be held at the Shoreham Hotel in Washington, D.C., March 23–25.

American Chemical Society. The 123rd national meeting of the American Chemical Society will be held at the Hotels Biltmore and Statler in Los Angeles, Calif., March 15–19.

American Planning and Civic Association. The 1953 annual meeting of the American Planning and Civic Association, called the Citizens National Conference on Regional Planning, will be held in New Orleans, La., March 11–14, with headquarters at the St. Charles Hotel.

American Power Conference. Headquarters for the annual meeting of the American Power Conference will be the Sherman Hotel, Chicago, Ill., March 25–27.

Chi Epsilon. The New York Alumni Chapter will visit the American District Telegraph Co., 155 Sixth Avenue, New York City, on April 1, at 7:30 p.m., for a demonstration of signal equipment. The trip will be preceded by an informal dinner meeting in the New York Times Dining Room, 11th Floor 229 West 43rd St., at 6 p.m.

Conference of the Building Officials Conference of America, Inc. The Hotel Baker in Dallas, Tex., will be headquarters for the 38th annual conference of the Building Officials Conference of America, Inc., April 6–9.

Eighth Western Metal Congress and Exposition. Sponsored by the American Society for Metals, in cooperation with Western divisions of 20 national technical societies, the Eighth Western Metal Congress and Exposition will be held in Los Angeles, March 23–27. Headquarters for the congress will be the Statler and for the exposition the Pan-Pacific Auditorium.

Ninth Annual Conference and Exhibition of the National Association of Corrosion Engineers. Technical sessions and the exhibition of the National Association of Corrosion Engineers are scheduled for the Sherman Hotel, Chicago, Ill., March, 16–20.

Second Southern Municipal and Industrial Waste Conference. The Second Southern Municipal and Industrial Waste Conference—sponsored jointly by Duke University, the University of North Carolina and North Carolina State College—will be held at Chapel Hill, N.C., March 19–20.

Sixth National Public Health Engineering Conference. Swimming pools and bathing beaches will be the theme of the Sixth National Public Health Engineering Conference to be held in the Student Service Center, at the University of Florida, Gainesville, March 24–25.

New Publications

American Society for Testing Materials. Specifications, test methods, and definitions developed by several ASTM committees have been compiled by the ASTM in a recent 307-page publication entitled *ASTM Standards on Mineral Aggregates, Concrete, and Non-Bituminous Highway Materials.* Standards cover aggregates, concrete, brick and block pavement materials, concrete curing materials, expansion joint fillers, and cement. A number of the standards are new, and many have been extensively revised. Copies, priced at $2.75 each, may be obtained from the ASTM, 1916 Race Street, Philadelphia 3, Pa.

Wood Research. The development of wood in the past century from the status of a natural resource having broad utility value into an engineering material with predetermined load-bearing capacities, is detailed by 26 experts in the field in *Proceedings of Wood Symposium on One Hundred Years of Engineering Progress with Wood*, published by the Timber Engineering Co., affiliate of the National Lumber Manufacturers Association. A compilation of outstanding papers presented at the wood symposium held during the Centennial of Engineering Convocation in Chicago, the publication is available in limited supply, without charge, on request to the Timber Engineering Company, Dept. WS-E, 1319—18th Street, N.W., Washington 6, D.C.

Manpower Utilization. The experiences in manpower utilization of more than 500 leading industrial companies and engineering organizations are pooled in a 52-page study released by the National Society of Professional Engineers. Second in a series of Research Reports based on surveys conducted by the NSPE, the publication is a guide book and manual for companies and organizations employing engineers and engineering services. The study, which is entitled *How to Improve the Utilization of Engineering Manpower*, may be obtained from the NSPE, 1121 Fifteenth Street, N.W., Washington, D.C. Copies are $2 each in lots up to 25, and prices for quantity lots will be quoted on request.

Concrete Research. Methods and results of investigations undertaken at the University of Illinois, under the auspices of the Engineering Foundation, in an attempt to throw new light on the behavior of reinforced concrete members subject to combined bending and axial load are described in Bulletin Series No. 399 of the Engineering Experiment Station. Eivind Hognestad, research assistant professor of theoretical and applied mechanics, is author of the bulletin, which sells for $1. Mr. Hognestad is also author of a historical study, entitled *What Do We Know About Diagonal Tension and Web Reinforcement in Concrete*, carried out at the Station in cooperation with the Bureau of Public Roads and the Engineering Foundation. Issued as Circular Series No. 64, the bulletin sells for 50 cents. Inquiries about both should be addressed to the University of Illinois, Urbana, Ill.

Road Test One-Md. A final report on Road Test One–Md.—a cooperative project of the Highway Research Board, twelve state highway departments, and other agencies, to determine the effect of controlled truck axle loadings on a concrete pavement test strip—have been issued as Special Report 4 of the Highway Research Board. Inquiries concerning the report, which sells for $2.25, should be addressed to the Board, 2101 Constitution Avenue, Washington 25, D.C.

World Power Conference. Annual statistics of world fuel and power production, distribution, and consumption for the years 1948–1950 and, where available, for 1951 are given in the *Statistical Year Book of the World Power Conference* (No. 6). Published in London by the Central Office of the World Power Conference, the 163-page publication sells for $5.25 a copy in the United States. Distribution here is through the Publication Sales Department of the American Society of Mechanical Engineers, 29 West 39th Street, New York 18, N.Y.

Water Resources, St. Louis Area. Greater St. Louis is one industrial area that need not worry about taxing its available water supplies for many years to come, according to recent findings of the U.S. Geological Survey reported in Geological Survey Circular 216, entitled *Water Resources of the St. Louis Area, Missouri and Illinois.* The Survey indicates that, counting surface supplies as well as potential groundwater and unconsumed water returned to the streams, the city is now using only a few tenths of 1 percent of the total amount available. Copies of the illustrated report may be obtained free on application to the Chief of Distribution, U.S. Geological Survey, Washington 25, D.C.

Ohio River Sanitation. To facilitate treating metal-finishing wastes, the Ohio River Valley Water Sanitation Commission has issued a new manual in its industrial wastes series. Techniques, reaction, and design considerations, as well as advantages and weaknesses of each method of treatment are provided in the 72-page illustrated manual. The publication may be purchased for $2, upon application to the Commission at 414 Walnut Street, Cincinnati 2, Ohio.

Concrete Research. In a revision of its *Current Road Problems* (No. 1-R), the Highway Research Board makes available current recommended practice for curing portland-cement-concrete pavement through the application of wet coverings, initial water spray, liquid-membrane seal coats, waterproofing paper, and protection against low temperatures. Inquiries should be addressed to the Highway Research Board, 2101 Constitution Avenue, Washington 25, D.C.

Boron Steel. Developments in the use of boron as a powerful constituent of engineering and mechanical steels are detailed in a revised edition of *Boron Steel* recently made available by the American Society for Metals. Inquiries concerning the 80-page publication should be addressed to the American Society for Metals, 7301 Euclid Avenue, Cleveland 3, Ohio.

Industrial Research. To meet the need for information on the vast research activities of private industry, the Research and Development Board of the Department of Defense and the Bureau of Labor Statistics of the Department of Labor have issued a

joint summary of such activity entitled, *Industrial Research and Development: a Preliminary Report*. About two-thirds of the national outlay for research and development in 1952, which came to about $3.5 billion, was performed in the laboratories and other facilities of American industry. Copies of the joint report may be obtained from the Research and Development Board, Department of Defense, Washington 25, D.C.

Housing Research. Recent and current housing research and facilities for conducting such research in the United States are described in *A Survey of Housing Research*, just issued by the Division of Housing Research of the Housing and Home Finance Agency. The 723-page volume, the first published survey in the field, is available from the Government Printing Office, Superintendent of Documents, Washington 25, D.C., for $3 a copy. The survey was made by the Building Research Advisory Board under a research contract with the HHFA to ascertain what research is being done in the housing field, where it is being conducted, and what facilities are available for further studies.

Concrete Pavement. Observations resulting from a two-year study of five sections of concrete pavement constructed without expansion joints and with weakened plane contraction joints spaced at 90-ft intervals are presented in Bulletin No. 3 of the University of Delaware Engineering Experiment Station. Authors of the report, a joint project of the university and the Delaware State Highway Department, are Charles N. Gaylord, M. ASCE, and Clyde N. Laughter, A.M. ASCE, both of the civil engineering department there. Inquiries concerning Bulletin 3, which sells for 50 cents, should be addressed to the University of Delaware Engineering Experiment Station, Newark, Del.

Ohio River Sanitation. *Disposal of Spent Sulfate Pickling Solutions* is the subject of another manual in the series being published by the Ohio River Valley Water Sanitation Commission to provide authoritative information on treatment methods for industrial wastes. Copies of the 76-page illustrated manual, priced at $2, may be obtained from the Commission, 414 Walnut Street, Cincinnati 2, Ohio.

Scientific Personnel. Issuance of a January 1953 edition of the semiannual publication, prepared by the Civilian Personnel Division of the Office of Naval Research and entitled *Current Scientific Vacancies in Naval Activities*, is announced by the Department of the Navy. The bulletin serves as a single source of readily available information on recurring civilian scientific and engineering vacancies throughout the naval establishment. Inquiries should be addressed to the office of Naval Research, Department of the Navy, Washington, D.C.

Engineering Manpower. For those interested in the current manpower problem, *Student Deferment in Selective Service*, by M. H. Trytten, affords an excellent summary of the situation. Dr. Trytten, director of the Office of Scientific Personnel, National Research Council, and general chairman of the Selective Service Scientific Advisory Committees, covers the history of Selective Service; the development of the student deferment program; the implications of the ROTC program; and the broader aspects of the manpower problem. Copies may be purchased from the University of Minnesota Press, Minneapolis, Minn., at $3 each.

Steel Reinforcing Bars. Simplified practice recommendations and commercial standards on Steel Reinforcing Bars have been issued by the Department of Commerce in cooperation with the National Bureau of Standards as Recommendation 26–50 (superseding R 26–49). The 15-page recommendation sells for 5 cents, upon application to the Superintendent of Documents, Government Printing Office, Washington 25, D.C.

Defense Program. The main accomplishments of the defense mobilization program since the beginning of the Korean invasion and the elements of the program that are at present unfinished are summarized in the eighth quarterly report to the President by the Director of Defense Mobilization, dated January 1. Entitled *The Job Ahead for Defense Mobilization*, the publication may be purchased from the Superintendent of Documents, Government Printing Office, Washington 25, D.C., for 30 cents.

Reservoir Evaporation. Researchers of the Navy, Interior, and Commerce Departments have completed studies of climatologic and hydrologic data gathered at Lake Hefner, near Oklahoma City, over a period of sixteen months. The studies revealed that the monthly evaporation from large bodies of water can amount to as much as 9 in.—a considerable loss in the operation of reservoirs, especially those holding water over long periods of time. The findings are published in a report issued jointly by the Navy Electronics Laboratory (NEL Report 327) and the Geological Survey (USGS Circular 229). Collaborating agencies, in addition to the Geological Survey and the Navy Electronics Laboratory, were the Bureau of Reclamation, the Bureau of Ships, and the Weather Bureau.

Solution to problem on page 60

As moisture-laden warm air from without came in contact with the cool ceiling of the subway, it was chilled to its dewpoint and the resultant dripping was from condensation rather than leakage. An adequate remedy usually would not be difficult to devise but, in this case, pedestrians were protected from the drip by a corrugated iron subceiling hung a few inches below the roof of the subway (a not infrequent makeshift). The subceiling immediately assumed the temperature of the subway air and its surface did not become a chilling medium to function like a cool plate held above the spout of a tea kettle.

RECENT BOOKS

Concrete Roads. (The Roadmakers' Library, Volume 11)

This book, by F. N. Sparkes and A. F. Smith, deals in a thorough, factual manner with the construction of concrete roads, special attention being paid to the soil and subsoil on which the roads are constructed. It covers the design of concrete mixes and control of quality; the design of pavements, both theoretical and practical; actual construction methods, machinery, and plant; defects, maintenance, and repairs. The comprehensive treatment includes the testing and treatment of soils, the chemistry of cement, details of joints and drainage, prestressed slab construction, stresses caused by traffic or slab warping, and many other special aspects. A bibliography of 200 references is included. (Edward Arnold & Co., London, 1952; Longmans, Green & Co., Inc., 55 Fifth Avenue, New York 3, N.Y., 1952. 492 pp., $15.50.)

The Nile

Based on hydrological data and surveys and also on general information collected by the Egyptian Government, this book deals with the past, present and future effects of the Nile River on all phases of life in Egypt and the Sudan. Each geographical section is discussed in relation to the river's effect on climate, health, and vegetation, as well as to river regulations and future projects planned to increase its irrigation and hydroelectric power facilities. The numerous illustrations include charts and tables. The author is E. E. Hurst. (Constable & Company, Ltd., London; Macmillan Company, 60 Fifth Avenue, New York 11, 1952. 326 pp., $6.)

International Association for Bridge and Structural Engineering, Publications. Volume 12, 1952

The seventeen papers presented here are individual contributions in English, French, or German, with summaries and table of contents in all three languages. Major topics treated are prestressed concrete structures, prefabrication in reinforced concrete, effects of periodic temperature variations on slabs and pillars, some problems in latticed structures, the design of small railway underbridges, the Vierendeel girder, and the aerodynamic characteristics of suspension bridges correlated with model tests. A few papers include bibliographies. (Published by the General Secretariat in Zurich (for sale by Verlag Leemann, Zürich). 324 pp., Sw. Frs. 38.00.)

Fatigue and Fracture of Metals

The fourteen papers that make up this book were presented as a symposium at M.I.T. in June 1950 by specialists in various aspects of the field. The subject matter came within the following major categories: General experience with failure of metals; specific fields in which it occurs; the internal mechanisms probably involved; significance of various metallurgical phenomena to fatigue; the potential usefulness of different research methods in investigating the fatigue condition and for countering it in design; and the direction of future research. The overall object was to consolidate existing knowledge of the phenomena and the major problems involved. (Edited by William M. Murray. John Wiley & Sons, Inc., 440 Fourth Avenue, New York, N.Y., 1952. 313 pp., $6.)

Handbook of Aerial Mapping and Photogrammetry

This manual, by Lyle G. Trorey, describes a variety of techniques for making maps from air photographs. The methods described are mainly the newer ones developed during and since the war. Procedures, calculations, and instruments are covered in logical order in a step-by-step manner. Appendixes contain a detailed presentation of the standard mapping procedure of the Royal Canadian Engineers, additional notes on the multiplex and stereoplanigraph, and a brief account of the Kelsh plotter. (Cambridge University Press, 32 East 57th Street, New York 22, N.Y., second edition, 1952. 180 pp., $6.)

Brückeneinstürze Und Ihre Lehren

A prize paper for 1947 and awarded the Silver Medal of the Eidgenössische Technische Hochschule, this publication (by Conrad Stamm) reviews some of the more important failures of steel bridges (not including military destruction) and the resulting lessons for the future development of steel bridge building. The several chapters deal with collapses during erection and during testing, failures from overloading and from other external causes, welded structures, aerodynamic instability, and general conclusions. Numerous photographs and drawings illustrate the text. (Verlag Leemann, Zurich, 1952. 99 pp., Sw. Frs. 12.50.)

(Continued on page 106)

Library Services

Engineering Societies Library books may be borrowed by mail by ASCE members for a small handling charge. The Library also prepares bibliographies, maintains search and photostat services, and can provide microfilm copies of any items in its collection. Address inquiries to Ralph H. Phelps, Director, Engineering Societies Library, 33 West 39th Street, New York 18, N.Y.

(Continued from page 104)

Covered Bridges of New England

A pleasant study by Clara E. Wagemann of the history, romance, poetry, and folklore of covered bridges, the book is a revised edition of the author's original work published in 1931. Included in the revision is information on bridges demolished since that time and a census of all New England and New York bridges standing in 1952 with their approximate locations mapped. Illustrated with etchings by George T. Plowman. (Charles E. Tuttle Co., Rutland, Vt., 151 pp., $5.)

Atmospheric Pollution. Its Origins and Prevention

This book, by A. R. Meetham, treats the whole subject of fuel pollution in Great Britain—principally in the forms of sulphur dioxide, smoke, and ash. It goes into the subjects of fuels, fuel-burning appliances and industrial processes, besides giving information on the measurement, distribution and effects of atmospheric pollution. Remedial measures are also considered, together with some legislative measures in England and the anti-smoke laws in the U.S. (Pergamon Press, Ltd., London, 1952. 268 pp., 35s.)

Positions Announced

United States Civil Service. Announcement has been made of a new examination for Engineering Draftsman and Statistical Draftsman, for filling positions in various federal agencies in Washington, D.C., and vicinity. Salaries range from $2,750 to $5,940 a year. Full information and application forms may be obtained from the U.S. Civil Service Commission, Washington 25, D.C., and from most post offices.

Engineer Center, Fort Belvoir. Openings available at the Engineer Center, Fort Belvoir, Va., include the following: One Engineering Draftsman at an annual salary of $3,795; five Civil Engineers at annual salaries ranging from $5,060 to $5,940; three General Engineers at salaries ranging from $5,060 to $5,940; and two Structural Engineers at salaries from $4,205 to $5,060.

District Public Works Office. The position of General Engineer, GS-11, at a minimum annual salary of $7,425, and a minimum of 18 months' employment, is now available in the Canal Zone. Benefits include a 25 percent pay differential, and transportation and housing for appointees and dependents. All qualified applicants—graduate engineers with experience in the field of maintenance and construction—should submit Standard Form 57 to the District Public Works Officer, Box "P", 15 ND Headquarters, Navy 121, Fleet Post Office, New York, N.Y.

Applications for Admission to ASCE, January 17–February 14

Applying for Member

James William Owen Baker, Baltimore, Md.
Thomas Browning Chambers, Washington, D.C.
Harvey Milton Cole, Jr., San Diego, Calif.
Clarence Newell Crocker, Sr., Atlanta, Ga.
Wilbur App Dexheimer, Denver, Colo.
Carroll Hilton Dunn, Vicksburg, Miss.
Bernard Eckenrode, San Diego, Calif.

Dean Austin Eichelberger, Seattle, Wash.
Baird Miller French, Phoenix, Ariz.
Philip Robison Gargés, Buffalo, N.Y.
Stanislaw J. V. Gawlinski, Boston, Mass.
Henry Pawel Herbich, Minneapolis, Minn.
Ralph Crooke Holt, Philadelphia, Pa.
Harry Edison Lloyd, San Francisco, Calif.
John MacLennan, Chicago, Ill.
William Marshall, Norfolk, Va.
Harry John McDargh, Jr., Atlanta, Ga.
Robert Kinsie McDonough, Atlanta, Ga.
Mervin Adam Minish, Bellevue, Wash.
Ladislas Vladimir Moshneanu, New York, N.Y.
Willard Daniel Everett Olson, San Diego, Calif.
Frank Edward Patten, Jr., Arlington, Va.
Clifford Emil Pehl, Sr., New York, N.Y.
Robert Anthony Puttman, Cincinnati, Ohio.
Adrianus Roggeveen, New York, N.Y.
Fred Hershel Ryan, Atlanta, Ga.
Peter Spat, Detroit, Mich.
Howard Joseph Snitoff, Chicago, Ill.
Fernando Munilla Solino, Havana, Cuba.
Joseph Alton Spence, Charleston, W. Va.
Frederick Thayer Stoddard, Albany, N.Y.
Glenn Ferdinand Sudman, San Francisco, Calif.
Howard Jones Teas, Malverne, N.Y.
Rudolf Waldemar Ullmann, Cleveland, Ohio.
Morris Marshall Viele, Moffett Field, Calif.
Frank Stevens Whitney, Huntington, W. Va.

Applying for Associate Member

Peter Graham Boosie, London, England.
Andrew Mercer Bristow, Baltimore, Md.
Jack Brown Bruno, Milwaukee, Wis.
Thomas Patrick Collier, Chicago, Ill.
Walter Jan Dmytryk, Rittman, Ohio.
Arnold Neil Dunham, San Diego, Calif.
Carl Edwin Ekberg, Jr., Fargo, N.D.
Homer Joseph Fallai, Sacramento, Calif.
Grovenor John Fox, Portland, Oreg.
Arthuro Hilario Geigel, Jr., Hato Rey, Puerto Rico.
John Melvin Gibson, Augusta, Ga.
Milton Frank Habush, Portland, Oreg.
Norman Bernhard Hansen, San Francisco, Calif.
George Charles Hanson, Denver, Colo.
Herbert Frederick Hilgers, San Antonio, Tex.
William Henry Jamison, Des Moines, Iowa.
Robert Adams Jewett, Pittsburgh, Pa.
Tien-Un Lee, Chicago, Ill.
Robert Kenneth Michaels, Orlando, Fla.
John Arthur Mitchell, New York, N.Y.
Chester Charles Moeller, Oak Ridge, Tenn.
John Peter Ottesen, Estes Park, Colo.
Alberto Cuevas Picon, Caracas, Venezuela.
Donald Speakman Rand, Denver, Colo.
Harry Roy Shannon, Kansas City, Mo.
Howard Carl Steavenson, Tyler, Tex.
Thomas Ewart Vaughan, Chile, S.A.
Melvin Warren Witham, Seattle, Wash.

Applying for Affilitate

Paul Edward Stryker, Richmond, Va.

Applying for Junior Member

James Franklin Bailey, Ocala, Fla.
Maurice Reeves Beachum, Suffolk, Va.
Richard Winston Barrow, Houston, Tex.
Bernardo Contreras Soto, Caracas, Venezuela.
Walter Owen Davis, Cambridge, Mass.
Robert Charles Engle, New York, N.Y.
Marvin Gates, New York, N.Y.
George Baker Gentry, Phoenix, Ariz.
Hans Gesund, New Haven, Conn.
William Anderson Griswold, Knoxville, Tenn.
Robert Julian Grubbs, Savannah, Ga.
Robert Owen Grubbs, Louisville, Ky.
Henry William Hauenstein, Toledo, Ohio.
William Henry Huddleston III, Nashville, Tenn.
Otho Lloyd Hudson, Jr., Wilmington, Del.
Govindan Jinarajan, Orissa, India.
Raymond Thomas Kask, Dallas, Tex.
George Ridgely Kelley, Bethesda, Md.
James Richard Koehler, Chicago, Ill.
Philip Carolan Lockette, Newark, N.J.
Richard Mascolo, New York, N.Y.
Lucian John Meyers, Sacramento, Calif.
Joseph Thomas Patrick Murphy, Boston, Mass.
Ernest Luther Pemberton, Albuquerque, N. Mex.
Waldo Clyde Preble, Wilmington, Del.
Jean Claude Richard, Montreal, Canada.
Arnold Neil Sakshaug, Whiting, Ind.
Arthur Philip Lambert Shallcross, Brisbane, N.E., Australia.
Edward George Shweiri, Boston, Mass.
Louis G. Silano, New York, N.Y.
Albert Swerdlow, New York, N.Y.
John Logan Tanner III, Dallas, Tex.
Herbert Eason Thornton, Chattanooga, Tenn.
Ismet Turkalp, Seattle, Wash.
George Irvin Vincent, Cheyenne, Wyo.
Syed Rafiuddin Wahed Ally, Ames, Iowa.
Glenn Samuel Wambold, Tucson, Ariz.
Edward Carson Woodward, Jr., Augusta, Ga.
Joseph George Zeitlen, Richmond, Va.

[*Applications for Junior Membership from ASCE Student Chapters are not Listed.*]

EQUIPMENT, MATERIALS and METHODS

NEW DEVELOPMENTS OF INTEREST AS REPORTED BY MANUFACTURERS

Shovel-Crane

A HEAVY-DUTY truck-mounted shovel-crane, providing 20 per cent more lifting capacity than previous Bantam models, has been announced. Conservatively rated at 6 tons capacity, the 3/8 yd heavy-duty Model T-35 is already in full production, with a complete line of matching attachments, including shovel, clamshell, dragline, back hoe, magnet, wood grapple and pile driver. Major improvements over previous Bantam Model M-49 machine include: a stronger main frame with 54 percent increase in section modulus; larger shafts and bearings throughout; bigger diameter center pin; newly designed trunnion base with wider trunnion rollers and the use of 4 adjustable cam-type hook rollers instead of three. The T-35's vertical swing shaft bearing allows for almost twice as much radial load on the shaft, compared to the M-49 model. Model T-35 offers more efficient performance because of substantial increases in both clutch and braking surfaces. A power boom hoist which gives power lowering as well as raising is retained as standard equipment in the T-35. Streamlining of the basic unit cab has resulted in 37.8 per cent more operator visibility for ordinary work. The full-revolving Model T-35 Bantam incorporates other advanced engineering features, such as: anti-friction bearings, machine-cut gears, internal expanding band type clutches with molded linings and positive "snap-in" rollers, external contracting brakes, band-type swing brake for locking basic unit in desired position, jackshaft-mounted tag-line which can be used either for ordinary tagline operation or for a power-operated shovel dipper trip. The heavy-duty Model T-35 Bantam can be mounted on any new or used tandem axle truck having a wheelbase of 164 in. or more. Suitable single axle trucks can also be used when ground conditions are favorable. **Schield Bantam Company, Waverly, Iowa**

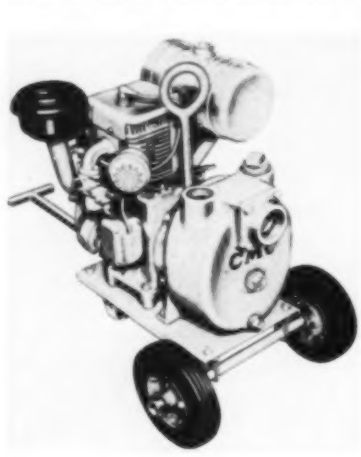
Model T-35

Compressor

AN "AUTO-AIR" compressor assembly suitable for mounting on standard panel type trucks, is announced. Known as Model 105-VBA, the unit delivers 105 cfm at 100 lbs pressure. It is driven directly from the truck engine through a Davey P-80 heavy duty power take-off. Compressor occupies only one-third of truck body, leaving the remainder open for the transportation of men, tools and materials. **Davey Compressor Co., Kent, Ohio**

Centrifugal Pump

A PORTABLE SELF-PRIMING centrifugal pump, is available in four sizes and seven models, all of which are powered with air-cooled engines. The sizes covered range from 1 1/2 in. through 4 in. The self-priming feature in the pump is accomplished through the medium of dual volutes. Pump cases are of the one-piece type and are self-cleaning, utilizing the sweeping action of the liquid to clean and remove solids from the pump case. At the point where the rotating impeller shaft enters the pump case, a rotary shaft seal is used in place of a conventional stuffing box. This rotary shaft seal is of the greaseless type requiring no lubrication, and the seal is protected from abrasive particles by a hydraulic seal at the rim of the impeller. In the design and construction of the pump, particular attention was given to reducing the number of parts and to effect savings in weight. The assembly of this pump is of the close coupled type to provide a compact, portable unit and the pump has been arranged so it is easily dismantled for service or inspection. **Construction Machinery Company, Waterloo, Iowa**



Dual Prime

Graders

MODELS 104 AND 118 motor graders are now available with General Motors 2-cycle diesel engines in addition to the International Harvester diesel engines which have heretofore powered these graders. The Model 104 grader will employ a GM 3-71 diesel engine, rated for this service at 85 hp; the Model 118 grader a 104 hp 4-71 GM diesel. Addition of the new line of engines gives the Galion 104 and 118 graders slightly more horsepower than was previously available. The move also has an advantage for many Galion grader users with GM diesel power in other equipment as it will enable them more readily to "standardize" their engines. Most moving parts from 3-71 and 4-71 GM diesels are interchangeable with any other 2, 3, 4, or 6 cylinder series 71 diesel as the bore and stroke is uniform throughout the series. **The Galion Iron Works & Mfg. Company, Galion, Ohio**

Increased Power with Diesel Engines

Plastic Joint Compound

PRODUCTION of new, improved Sewertite, a cold plastic sewer joint compound, has been announced. Civil and sanitary engineers prefer Sewertite because its thermoplastic properties give joints tight but flexible sealing, and it provides greater resistance to cracking than ordinary rigid cement or hot sealing compounds. A scientific formula combining bitumens, organic additives, asbestos fibres, mineral stabilizers and solvents Sewertite's heavy trowel consistency plus a new additive give the compound extra adhesive powers. Sewertite is acid and alkali resistant, waterproof, flexible and permanent. Other advantages include immediate back-fill after application, flexible joints which remain pliable, reduction of danger of root break through and long life without joint repair. **The Philip Carey Mfg. Company, Dept. SP, Cincinnati 15, Ohio**

Equipment, Materials & Methods (Continued)

Loadstar Truck

THE RF-194 LOADSTAR model with concrete mixer body, was one of a group of six-wheel models introduced with the company's R-line motor trucks. The truck has a gross vehicle weight rating of 38,000 lbs and is typical of the heavy-duty six-wheelers International has introduced for both highway and off-highway service. RF-190 series six-wheelers (GVW 30,000 to 38,000 lbs) except the RF-195 road-

RF-194 Model

liner, are powered by the 154 hp Super Red Diamond 406 engine. RF-195 Roadliners are powered by the 162-hp Super Red Diamond 450 engine. Other International six-wheelers, available with GVW ratings from 22,000 to 45,000 lbs, include the RF-170 series models (GVW 22,000 to 26,000 lbs) and the RF-210 series (GVW 37,000 to 45,000 lbs.) All International six-wheel models are available with gasoline or LPG fuel systems. Models in the RF-190 series are also available with diesel power. International R-line trucks are newly styled and are identified by the distinctive IH emblem, replacing the famed Triple Diamond. **Consumer Relations Department, International Harvester Company, 180 North Michigan Ave., Chicago 1, Ill.**

Protective Coating

A PROTECTIVE COATING for forms used in concrete construction has been developed. The product is now available for commercial use under the name Technicote Form Coating B-5009, a specially formulated material for a specific purpose. The protective film is highly resistant to abrasion, chipping, weathering, and alkali action of concrete. When properly applied Technicote B-5009 imparts a smooth, even finish to the wood, which binds the surface grains firmly in place and seals the wood pores rendering the form waterproof. There is absolutely no adhesion at the concrete and form interface and the forms may be easily stripped leaving a fine grade finish on the concrete surface. **L. J. Kissling & Sons, P. O. Box 21, Long Island City, N. Y.**

When Requesting Product Information Please Mention Civil Engineering

Equipment, Materials & Methods (Continued)

Heavy-Duty Trailer

THE MODEL R4TL alloy steel trailer, built throughout with high strength alloy steel, weighs less than 8,000 lbs yet has a payload capacity of 27 tons. The trailer was primarily designed to haul equipment in the Caterpillar D8 weight class, and still remain within legal axle load limits in most states. The high strength alloy steel has reduced dead weight to a minimum.

Model R4TL

The frame, fabricated of structural members, is electrically welded into a unit of immense strength. Field tests were made, using a Caterpillar D8 tractor, equipped with a cable-controlled-lead dozer, canopy and side hoods. Extremely muddy conditions increased the weight of the tractor to 51,640 lbs. The tractor was loaded over the rear and the dozer was rested on the gooseneck. Recorded weights, on a registered scale, showed 4,920 lbs on the truck's front axle; 31,320 lbs on the truck's tandem; and 31,820 lbs on the trailer tandem. The truck itself weighed 8,640 lbs. The trailer has an 8 ft by 13 ft platform, with an overall length of 27 ft 7 in. from kingpin to extreme rear. This trailer also features the patented Martin tandem axle assembly, a full oscillating assembly mounted on Neoprene for silent trouble-free operation with no moving parts to wear out and no lubrication required. **Martin Machine Co., Kewanee, Ill.**

Snow Plow Wax

A UNIVERSAL TYPE snow plow wax, suitable for both brush and spray application, is announced. Known as Snow-Rem "Universal", its use eliminates the necessity for thinning ordinary waxes for spray use or for stocking both spray and brush wax. The wax possesses high Carnauba content and also includes a silicone additive. The latter is reputed to produce an extra slippery surface coating and to possess unusual adhering qualities. By coating snow plow blades, moldboards and wings with Snow-Rem, operators can increase their daily plow mileage as much as 30 percent. Because snow slides rapidly off the waxed surface, piling is prevented and substantial motor fuel savings are effected. The wax is also an effective anti-rust coating. **Speco, Inc., 7308 Associate Ave., Cleveland 9, Ohio.**

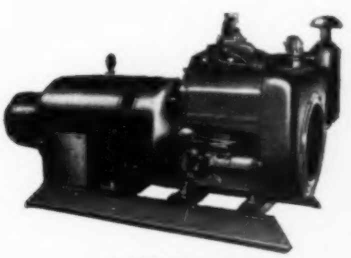
Equipment, Materials & Methods (Continued)

Space-Scale

THE SPACE-SCALE, a combination slide-rule and scale with no moving parts, is a labor-saving device which measures areas from scale drawings at a glance. A second look gives you volumes if the third dimension is known. It is made of 5 by 5 in. transparent vinylite, printed in two colors and laminated. The Space-Scale operates by placing over drawing of space to be measured and reading figure on curve. Adaptable for use on any fractional inch scale drawing. Measures circles and cylinders as easily as rectangles and cubes. Other uses: a fast slide-rule; multiplication, division, square roots. Eliminates trial and error calculations. **John D. Kreuttner, New—Era Products, 6 Peter Cooper Road, New York 10, N. Y.**

Electric Plant

AN ULTRA-MODERN and electric generating plant, engineered primarily for emergency stand-by service, is announced. The model has a 10 KW capacity suiting it for a wide range of applications, hospitals, theaters, commercial buildings, industrial plants, construction projects, etc. It is available with electric starting or can be supplied with controls which automatically start the plant the instant regular power fails. An important feature is its four cylinder air cooled gasoline engine. Not having a water cooling system to require attention, the plant's maintenance needs are reduced to an absolute minimum. The modern design of the plant, with its close coupled engine and generator, makes it an extremely compact unit, saving on installation space. The plant provides an ideal combination of low initial and minimum operating expense. It can be furnished for single phase or three phase service, at either standard or special voltages. **Universal Motor Company, 494 Universal Drive, Oshkosh, Wis.**



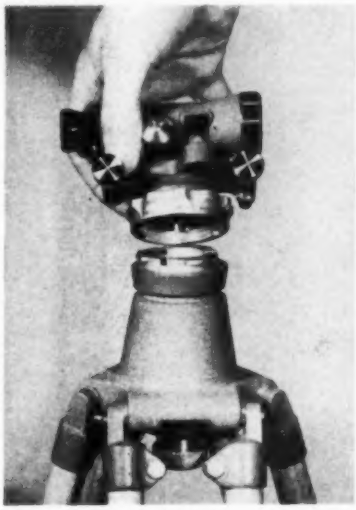
10 KW Capacity

When Requesting Literature Please Tell The Manufacturers You Saw Their Products Mentioned in Civil Engineering

Equipment, Materials & Methods (Continued)

Optical Level

PRECISION AND craftsmanship, synonymous with Swiss products for years, have been incorporated into the Kern GK-1 optical level for contractors, engineers, architects and surveyors. The instrument has no foot screws but a ball-and-socket joint instead, which, in connection with a bulls-eye level, allows perfect leveling up in a matter of seconds. Ball joints used heretofore on other types of (European) surveying instruments were found to



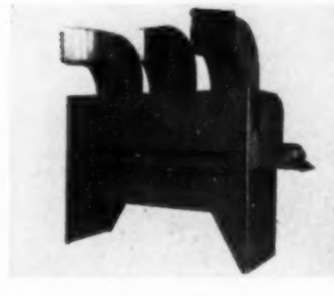
GK-1

lack stability and for that reason were not readily accepted. This problem has been solved on the Kern GK-1 with a quick-coupling joint. The operator merely places the instrument on its tripod, gives it a firm twist into place, and the two components become a firm, rigid whole. After the instrument has been leveled with the bulls-eye device (read through a mirror tilted at a 45 deg angle), a fine tilt screw is adjusted to bring the telescope into perfect level. Coincidence prisms reflect parallax-free images of opposite ends of the spirit level bubble. When viewed through a 2-power lens near the eyepiece, these appear as quarter circles. Adjustment is continued delicately until they combine to form a semicircle. At that time the line-of-sight is guaranteed to be within one second of true level, or $^1/_{3600}$ of one degree. As on most American models, the telescope glass has stadia lines for distance readings. That portion of a rod cut off by these lines, if read in decimals of a foot, will give the distance from the instrument axis to the rod, expressed in feet. The GK-1's counterpart is the GK-1C which is provided with a horizontal circle, divided into 360 deg. It can be set to a zero reading at any point and a magnifying glass permits direct readings to $^1/_{10}$ of a degree and estimated readings to $^1/_{20}$. **Kern Surveying Instrument Div., Paul Reinhart Co., 66 Beaver St., New York 4, N. Y.**

Equipment, Materials & Methods (Continued)

Industrial Heaters

AN IMPROVED LINE of industrial heaters, which deliver volumes of heated air for large areas which cannot be serviced by more conventional methods, is available. The self-contained units, which



range from 100,000 to 2,500,000-btu per hour in heating capacity and from 2,000 to 25,000 cfm in air velocity, may be floor, wall or ceiling mounted. They may be mounted in either upright or inverted position when wall mounted. The line includes a heavy duty model designed especially for steel, rubber, and paper mills. **Westinghouse Sturtevant Div., Dept. T-535, 200 Readville St., Hyde Park, Boston 36, Mass.**

Metal for Aluminum Soldering

THE AVAILABILITY OF Chemalloy as an improved and simplified means for the soldering and welding of aluminum, is announced. Aluminum is one of the more difficult metals to weld and solder because of the surface oxide which exists whenever aluminum is exposed to air. This oxide protects aluminum against exposure and keeps the metal bright and attractive. However, it prevents solder from adhering unless it can be penetrated. Such surface oxides cannot be removed by mere heat since it will not dissolve below the disintegration temperature of aluminum. As a consequence, it has normally been necessary to use corrosive fluxes, high skill and elaborate facilities to work with aluminum. Chemalloy is important because no flux and the simplest of techniques and facilities suffice. Chemalloy will solder or weld any solid aluminum or zinc-base metal regardless how thin a gauge down to foil or screening. It will also function with aluminized or aluminum-coated steel or other base metal. It functions with galvanized surfaces on galvanized iron. The material is expected to facilitate the expanding use of aluminum and make more feasible the transition from critical copper to plentiful aluminum. The lower cost and greater volume per lb of aluminum with respect to copper are important factors in this connection. **Chemalloy Associates, Gillespie Airport, Santee, Calif.**

Equipment, Materials & Methods (Continued)

Diesel Power-Package

THE, "P & H diesel power-package," is a complete power unit that is engineered for simple installation in any make shovel. The replacement package is built around P & H's model 387-C, 2-cycle, 3-cylinder diesel engine of 60 hp Included in the power package is all equipment required for shovel installation; mounting brackets to fit original engine bed, necessary controls and power connections and reduction gear, if needed. Tests, with this replacement diesel, show very substantial savings in operating costs over shovels powered by other types of engines. Simplified maintenance and greater accessibility are important features of the shovel engine. Illustrating these, P & H points to its patented cylinder head and liner assembly which can be replaced as a unit in less than one hour. **Harnischfeger Corporation, Diesel Engine Div., Crystal Lake, Ill.**

Elevating Grader Attachment

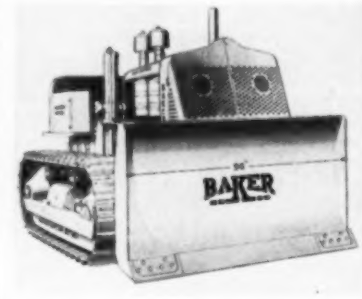
THE B & L heavy-duty elevating grader attachment eliminates unnecessary handling of dirt—puts the material right where it is needed—fast. Overburden can be removed in quarries now as fast as a fleet of trucks can carry it away. Shaping shoulders can be done in one operation as the trucks carry away the waste material. One man can strip and cast any kind of soil into terraces at lowest possible cost of manpower and equipment. Power take-off; direct connection to motor drive shaft with Vee Belt Drive connecting through heavy duty disc clutch controlled from cab of grader; and the standard length carrier quickly and easily extended by inserting one or two three-foot sections are among its many features. The fingertip hydraulic controls on the standard grader are used for controlling attachment except for readily installed belt drive control lever furnished with attachment. The elevating attachment is designed for easy attachment to the grader. The elevator can be removed and the blade and other equipment placed on the grader readily. The heavy fabricated frame throughout with boxed sections and heavy plate gussets withstands rugged shock loads. A special heavy duty double auger flight cat hole cleaner with shear pin is readily accessible for replacement if necessary. **Barnard & Leas Mfg. Co., Inc., Cedar Rapids, Iowa**

Easily attached to grader.

Equipment, Materials & Methods (Continued)

Bulldozer

Following successful development of the earthmoving industry's first big "no pushbeam" bulldozer, the 9X, the company announces production of the bigger, more powerful, new Baker 15X, which puts more horsepower than ever to work on the dozer blade. Developed in cooperation with Allis Chalmers, the 15X mounts on the A-C HD-15 tractor, and features integral tractor-dozer construction; legal highway portability (without permits)—only 96 in. wide; big yardage capacity—51 in. high moldboard; 39-1/2 in. blade and 15-1/2 in. drop below ground; greater track oscillation; center of gravity permitting draw bar work with dozer mounted; operator-ease control; design for easy servicing, and less weight—lower cost. **Baker Manufacturing Company, Springfield, Ill.**



Baker 15X

Electrode Holder

A 400 ampere insulated electrode holder, the Cooltong, has been announced. The Cooltong holder has several patented features which field tests have proved to give longer service life and cooler operation than is normal with holders of similar capacity. In one test made with the holder, it remained cool enough to weld with bare hands when using 400 amperes current. The nose is a special "sandwich" construction consisting of a copper core between four and six layers of laminated, glass impregnated, plastic cloth. This patented construction gives longer service life because the copper core, in addition to being reinforcement, dissipates heat so that it will not concentrate in the nose causing deterioration in the insulation. The jaws, covered by this special insulating construction, are made of tough, highly conductive, Mallory 3 Metal, non-spatter type. They will handle electrodes from 1/8 to 5/16 in. in size and have a wide opening to permit fast release of stubs. Current carrying frame parts are made of pure copper for high conductivity. These parts are reinforced with steel to increase the rigidity and strength of the frame. **The Lincoln Electric Company, 22801 St. Clair Ave., Cleveland 17, Ohio.**

Literature Available

Form Erection—A 4-page bulletin "How to Erect the Symons Forming System," is available. Erecting and stripping advantages are explained in a short, factual manner. The system and what it consists of is described, including—panels, corners, pilasters, and fillers, waler tie, tightening wedge, short connecting bolt, two way form tie and long connecting bolt. Detailed information is given on the high strength panel, light construction panel and all-wood panel. **Symons Clamp & Mfg. Co., 4249 Diversey Ave., Chicago 39, Ill.**

Electric Power Distribution Practices—A bulletin, a guide for plant engineers on electric power distribution practices in large and small plants, has been announced. The 28-page, illustrated, two-color bulletin, designated as GEA-5900, is entitled "Industrial Power Distribution Idea Book." The publication covers utility distribution practices; methods of buying electric power; what to do when a choice of primary voltages is available; application of primary switches and circuit breakers; types and arrangements of primary cables; and types of load-center distribution systems. **General Electric Company, Schenectady, N. Y.**

Load-Packers—A colorful 12-page catalog, "How to Reduce Refuse Collection Costs," has been issued. The catalog illustrates and describes the Gar Wood Load-Packer, presenting statistics and examples of how every sized community can reduce refuse collection cost and offer better service to its citizens. Ask for Bulletin W-110. **Gar Wood Industries, Inc., Wayne, Mich.**

Laminated Members—A 20-page catalog, "Rilco Glued Laminated Wood Arches, Beams and Trusses" illustrates basic shapes and shows their application in construction of churches, school classrooms, gymnasiums, commercial and industrial buildings. Basic design data, dimension tables and connection details are also included. **Rilco Laminated Products, Inc., First National Bank Bldg., St. Paul 1, Minn.**

Centrifugal Pump Selection—A broad line of centrifugal pumps applicable to most industries is highlighted in a "Handy Guide to Selection of Centrifugal Pumps." In addition to covering general purpose, double suction, multi-stage, special purpose, marine and mixed and axial flow pumps, the bulletin has a head-capacity table for single stage, double suction Allis-Chalmers pumps. Special purpose pumps mentioned include solids handling, paper stock, sewage, rubber-lined, process, fractional horsepower and collant and circulating units. **Allis-Chalmers Manufacturing Company, 1187 S. 70th St., Milwaukee, Wis.**

Literature Available (Continued)

$^1/_2$ Yard Shovel-Cranes—Book No. 2428 has 24 pages fully illustrated, featuring Link-Belt Speeder 51 series crawler-mounted LS-51, truck mounted HC-51 and wheel-mounted MS-51 models. **Link-Belt Speeder Corp., Adv. Dept., 397 North Michigan Ave., Chicago 1, Ill.**

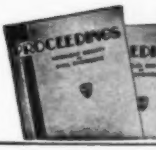
Safety Treads—As a companion to the Threshold Book, a similar reference that covers practically every type of safety tread application has been issued. Comprising 36 pages in handy pocket size, it shows illustrated plates, cross-section drawings, typical installations and specifications for safe-groove and abrasive cast treads as well as expansion plates, platforms, curb bars and floor grids. The book offers quick, complete information to anyone concerned with the design, application, repair or purchasing of safety treads. **Wooster Products, Inc., Department C, Wooster, Ohio**

Hydraulic Torque Converter Drives—A bulletin discloses how truck-type three-stage hydraulic torque converter drives improve performance, prolong equipment life and prevent operator fatigue in heavy hauling. The bulletin describes application to on-highway and off-highway units, and explains the dual advantages of highest torque multiplication for pulling and torque converter braking, both exclusive in twin disc converters. **Twin-Disc Clutch Company, Hydraulic Div., Rockford, Ill.**

Self-Priming Pump—A bulletin on a newly designed $1^1/_2$ in. self-priming centrifugal pump has just been issued. It illustrates and describes the versatile gasoline engine driven pump which is extremely portable and very easy to carry by one person. Ask for Bulletins No. 151 and 152. **Carver Pump Company, Muscatine, Iowa**

V-Belts—An 8-page, four color catalog on V-Belts for industrial use is available. New simplified conversion tables are a feature of this publication whereby a user can determine, more quickly and easily than ever before, the correct Thermoid belt to replace the belts of other manufacturers. Prices, dimensions, weights and construction details are also presented. **Thermoid Company, 200 Whitehead Road, Trenton, N. J.**

Ion Exchangers—A 28-page bulletin, "Demineralization including Silica Removal by Ion Exchange" helps explain one of the newer roles that ion exchangers are playing in industry. Bulletin 3803, describes the chief applications, principles of operation, design features, advantages, recommendations and specifications of Permutit's demineralizing and silica removal apparatus and synthetic resins. **The Permutit Company, 330 West 42nd St., New York 36, N. Y.**



PROCEEDINGS AVAILABLE

The following papers, printed as Proceedings Separates, may be ordered on the basis of summaries given in this and previous issues of CIVIL ENGINEERING. Discussions of these papers will be received, as in the past, for a period of five months following the date of issue. A summary of each paper appears in several consecutive issues; other titles will be added every month, as they become available. Use the convenient order form on page 120.

Summarized in Earlier Issues

D-77. Discussion of Paper, **Buckling Stresses for Flat Plates and Sections,** by Elbridge Z. Stowell, George J. Heimerl, Charles Libove, and Eug ne E. Lundquist.

D-89. Discussion of Paper, **Deflections in Gridworks and Slabs,** by Walter W. Ewell, Shigeo Okubo, and Joel I. Abrams.

D-90. Discussion of Paper, **Consumptive Use of Water by Forest and Range Vegetation,** by L. R. Rich.

D-91. Discussion of Paper, **Consumptive Use of Water,** by Harry F. Blaney.

D-93. Discussion of Paper, **Aircraft Design as Related to Airport Standards,** by Milton W. Arnold.

D-97. Discussion of Paper, **Consumptive Use in the Rio Grande Basin,** by Robert L. Lowry.

D-98. Discussion of Paper, **Consumptive Use of Water on Irrigated Land,** by Wayne D. Criddle.

D-99. Discussion of Paper, **Consumptive Use in Municipal and Industrial Areas,** by George B. Gleason.

D-101. Discussion of Paper, **Application of Highway Capacity Research,** by J. P. Buckley.

D-102. Discussion of Paper, **Utilization of Ground Water in California,** by T. Russel Simpson.

D-103. Discussion of Paper, **Pile Foundations for Large Towers on Permafrost,** by L. A. Nees.

D-105. Discussion of Paper, **Principles of Highway Capacity Research,** by O. K. Normann.

D-112. Discussion of Paper, **Diversions from Alluvial Streams,** by C. P. Lindner.

Third Notice

164. **Water Supply Engineering, a Report of the Committee on Water Supply Engineering of the Sanitary Engineering Division for the Period Ending September 30, 1951.**

165. **Design Curves for Anchored Steel Sheet Piling,** by Walter C. Boyer and Henry M. Lummis, III.

166. **The Design of Flexible Bulkheads,** by James R. Ayers and R. C. Stokes.

167. **Sewage Disposal in Tidal Estuaries,** by Alexander N. Diachishin, Seth G. Hess, and William T. Ingram.

168. **Special Design Features of the Yorktown Bridge,** by Maurice N. Quade.

D-117. Discussion of Paper, **The Development of Stresses in Shasta Dam,** by J. M. Raphael.

D-122. Discussion of Paper, **Engineering Aspects of Diffraction and Refraction,** by J. W. Johnson.

D-125. Discussion of Paper, **Torsion of Plate Girders,** by F. K. Chang and Bruce G. Johnston.

Second Notice

169. **Rating Curves for Flow over Drum Gates,** by Joseph N. Bradley. The increasing demand for better methods of measurement of water in canals and dams, and the need for additional rating structures, prompts the author of this paper to demonstrate that numerous control structures can be used as metering stations. He explains that rating curves can be prepared in the office for radial gates, drum gates, valve installations, and other hydraulic structures. In particular, this paper illustrates the preparation of such curves for the rating of drum gates. (Available March 1.)

170. **Rapid Computation of Flexural Constants,** by Thomas G. Morrison. The introduction and computation of simple functions that may be combined to yield values of the flexural constants are explained and systematized in this paper. This procedure simplifies the computation of these constants and is adaptable to numerical integration. The formalized procedure requires a minimum of integration. The author presents for discussion the necessary equations and two examples of their application to beams of varying section. (Available March 1.)

171. **Unified Mass-Transportation System for New York,** by William Reid. A change in transportation philosophy is proposed, as applied to commuters in a metropolitan area. Using the metropolitan area of greater New York City as a "laboratory specimen," the author maintains that rail lines should most logically be used for mass transportation to the heart of the area, with feeder bus lines and private cars serving the rail-loading points in the suburbs. (Available March 1.)

172. **Aeronautical Charting and Mapping,** by Charles A. Schanck. Charting and mapping standards of the U. S. Coast and Geodetic Survey are outlined, as applied to the special needs of the aviator and of those who lay out air transport lanes and terminal facilities. Among the specialty maps described are the "Sectional Aeronautical Charts of the United States," world aeronautical charts, small AL charts and airport obstruction plans. (Available March 1.)

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173. **Electronic Devices in Air Transport,** by F. B. Lee. Current activities of the Civil Aeronautics Administration in providing ground facilities to aid air navigation are described. The "common" system of traffic control, designed to serve civic and military demands, in common, is discussed in considerable detail. Included also are references to the omni-range directional receiver, distance-measuring equipment, the course line computer, precision approach radar, and an airborne radar safety beacon. (Available March 1.)

174. **Zoning Maps for Airports,** by Benjamin Everett Beavin, Sr. A useful brief discussion of the best zoning practices in this special field, with recommendations for further improvement, is presented. For the most part, it is based on *Technical Standard Order No. N 18* of the Civil Aeronautics Administration, issued on April 26, 1950. Tabular data are given to indicate the author's recommendation for methods of defining airport approaches over an unusually broad range. The paper does not attempt to discuss the question of safety of the airport's neighbors, or land use control. (Available March 1.)

175. **Design of Side Walls in Chutes and Spillways,** by D. B. Gumensky. The pressures exerted on the side walls of spillways by the water flowing down a steep slope presents a special problem, particularly if the water is deflected by a vertical curve at the bottom of the spillway. The effect of the steepness of the slope on the design computations for the side walls, and the importance of considering centrifugal force and the entrainment of air in these computations, are explained in this paper. (Available March 1.)

D-121. Discussion of Paper, **Rate of Change of Grade per Station,** by Clarence J. Brownell. The original paper, published in March 1952, urged the adoption of a method of describing vertical curves which will give an immediate impression of the sharpness of such a curve. It is thought that the paper provides a useful tool for the design of divided highways and on-and-off ramps. Discussers are: T. F. Hickerson, Robert T. Howe, E. N. Prouty, and C. J. Brownell. (Available March 1.)

D-127. Discussion of Paper, **Stresses in Deep Beams,** by Li Chow, Harry D. Conway, and George Winter. In the original paper, five cases of loading on single-span beams are studied. The beams all have small span-to-depth ratios. Distribution and magnitude of bending and shear stresses are given in graphical and tabular form suitable for direct use in design. Special consideration is given to the use of this information in connection with reinforced concrete design. Discussers are: Arturo M. Guzmán and Cesar J. Luisoni, William A. Conwe and Harry D. Conway and George Winter. (Available March 1.)

First Notice

176. **Advances in Sewage Treatment and Present Status of the Art: Progress Report of the Committee of the Sanitary Engineering Division on Sewerage and Sewage Treatment.** Information on developments throughout the field of sewerage and sewage treatment during the period from January 1, 1950, to October 1, 1951, is presented for consideration by the profession. The control of water pollution, new projects and methods of treatment plant operation, chemical treatment, the disposal of sewage and sludge, and litigation are among the many subjects treated. A bibliography of literature pertinent to the period of the report is appended. (Available April 1.)

177. **Earthquake Stresses in Shear Buildings,** by M. G. Salvadori. A practical step-by-step procedure for determining the elastic stresses in a multistory building if it is subjected to earthquake displacements is presented. Incidental factors such as the rocking of a building on an elastic soil and the influence of internal damping are adroitly provided for. (Available April 1.)

178. **Rainfall Studies Using Rain-Gage Networks and Radar,** by H. E. Hudson, Jr., G. E. Stout, and F. A. Huff. The results of research in the measurement of rainfall by means of dense rain-gage networks and by means of radar are presented for consideration in this paper. The multicellular characteristic of thunder-storm rainfall is studied, and area-depth data are presented. It is indicated that radar is of superior or equal value in studying rainfall, as compared with rain-gage networks. The equipment and procedure for such radar studies are described, and data resulting from this work are presented. (Available April 1.)

179. **Stiffness Charts for Gusseted Members Under Axial Load,** by John E. Goldberg. This paper presents charts that yield values of flexural coefficients to be used in a slope-deflection and moment-distribution analyses of secondary stresses in truss members or in the stability analysis of trusses. The actual gussets are assumed to have been replaced by shorter gussets of infinite rigidity. Workers in the specialized field of stability and secondary stresses in truss members should find the mathematical development and the charts useful and worthy of study. (Available April 1.)

180. **A Direct Step Method for Computing Water-Surface Profiles,** by Arthur A. Ezra. A semi-graphical method for the computation of backwater curves, based on Bernoulli's theorem, has been developed in this paper. The effects of eddy losses, bridge-pier losses, and overbank flow can be included. This method should prove interesting to hydraulic engineers because of its convenient general applicability and special usefulness in computing many water-surface profiles for a single channel. (Available April 1.)

D-123. Discussion of Paper, **Long-Period Waves or Surges in Harbors,** by John H. Carr. This paper reports on field and model studies of sources and characteristics of long-period waves in harbors, the subjects of basin resonance, water motion induced by the waves, and the adaptability of models to this type of study. Discussers are: John S. McNown, B. W. Wilson, and John H. Carr. (Available April 1.)

D-126. Discussion of Paper, **Variation of Wind Velocity and Gusts with Height,** by R. H. Sherlock. The standard of reference of this paper is flow of air in level, open country, with recommendations based on velocity pressures rather than on design pressures. Discussers are: W. Watters Pagon, Irving A. Singer and Maynard E. Smith, Percy H. Thomas and M. H. Fresen, Robert A. McCormick, Edward Cohen, and R. H. Sherlock. (Available April 1.)

D-128. Discussion of Paper, **Horizontally Curved Box Beams,** by Charles E. Cutts. The original paper, published in May 1952, derived equations for the stresses and deformations of a beam curved horizontally through an angle of 90° and resting on four supports. This beam was considered to be of hollow cross section. The testing of curved box beams was described and the results of the experiments were presented. Discussers are: A. George Mallis, DeForest A. Matteson, Jr., and Charles E. Cutts. (Available April 1.)

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